



# Progress

RQ1: Given a text, identify the inherent motivation as per Maslow hierarchy of needs.

# Approach

- ▶ Finetune neural language models such as BERT, for **multi-label** classification task.
- ▶ 6 classes - {physiological, stability, love, esteem, spiritual growth, none}
- ▶ Dataset :  
Link for the paper: <https://arxiv.org/pdf/1805.06533.pdf>  
Link for the Video: <https://vimeo.com/285805584>  
Link for the data: <https://uwnlp.github.io/storycommonsense/>

# Data preprocessing

- An example text as annotated by different annotators:
- Challenges:
  - Data had empty strings and "na" values.
  - Few motive worker id was mentioned as NAN.
  - Motivation, Maslow, Reiss categories were not in a correct format for the model to be implemented.

## Preprocessing steps:

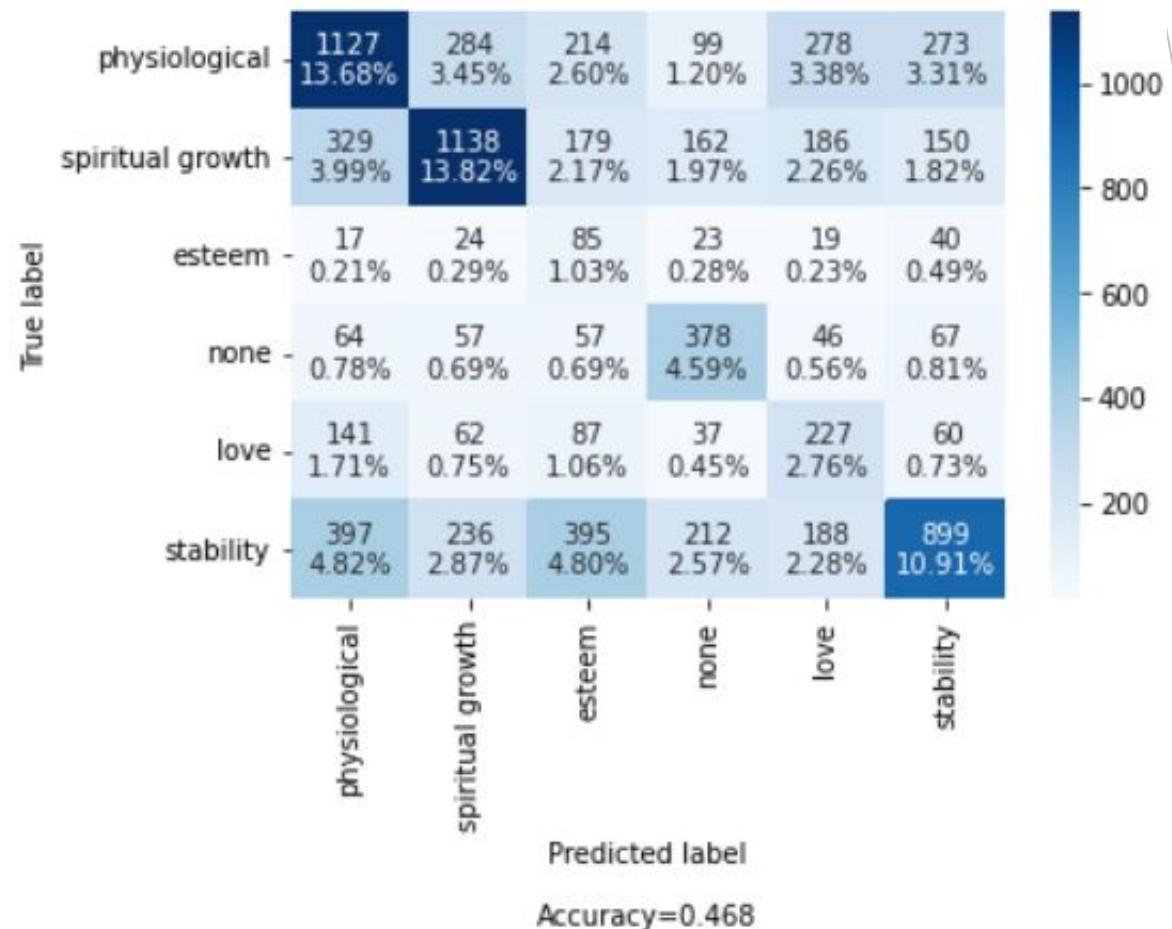
- Removing workers whose id was NAN.
- Removed empty strings in Maslow and Reiss category.
- Replaced "na" (no answer) in Maslow and Reiss column to "None".**
- Made motivation and Reiss column a string type.
- Merged columns sentence and context to include the context too while predicting the classes.
- Made sure a sentence along with its context is mapped to 1 Maslow and 1 Reiss category by Majority voting among 6 annotators.

No of sample text after preprocessing: 55,066 samples to 20,593 samples

| Motive worker id | context   | sentence   | motivation        | Maslow               | Reiss     |
|------------------|---|--|-------------------|----------------------|-----------|
| ann0             |   | I began making fish curry for my boyfriend and I.                  | ["eat some food"] | ["physiological"]    | ["food"]  |
| ann0             | I began making fish curry for my boyfriend and I. | I decided not to read a recipe since I've made so many in my life. | ["to help out"]   | ["spiritual growth"] | ["indep"] |

# Classification {original, imbalanced data}

| sentence         |      |
|------------------|------|
| maslow           |      |
| esteem           | 5187 |
| love             | 4502 |
| none             | 2543 |
| physiological    | 2277 |
| spiritual growth | 2360 |
| stability        | 3724 |



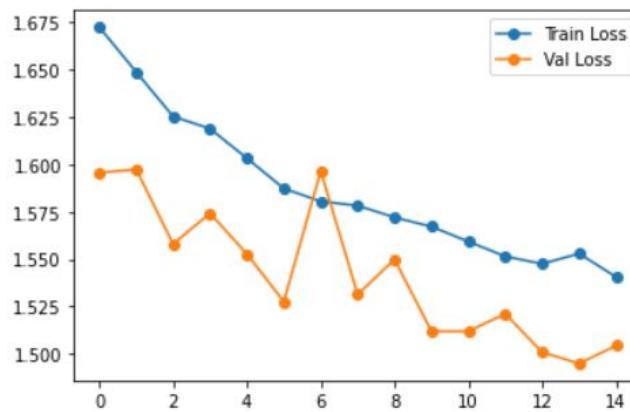
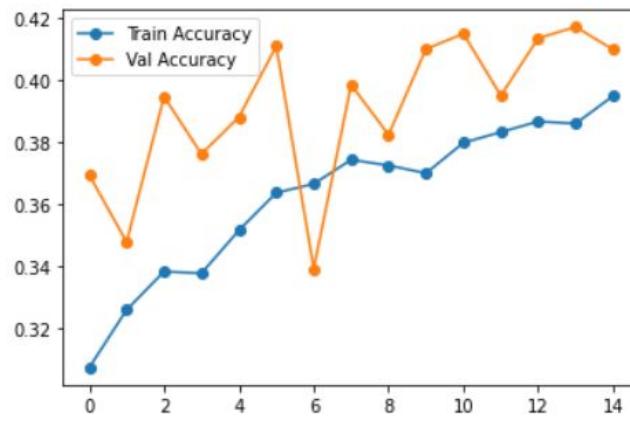
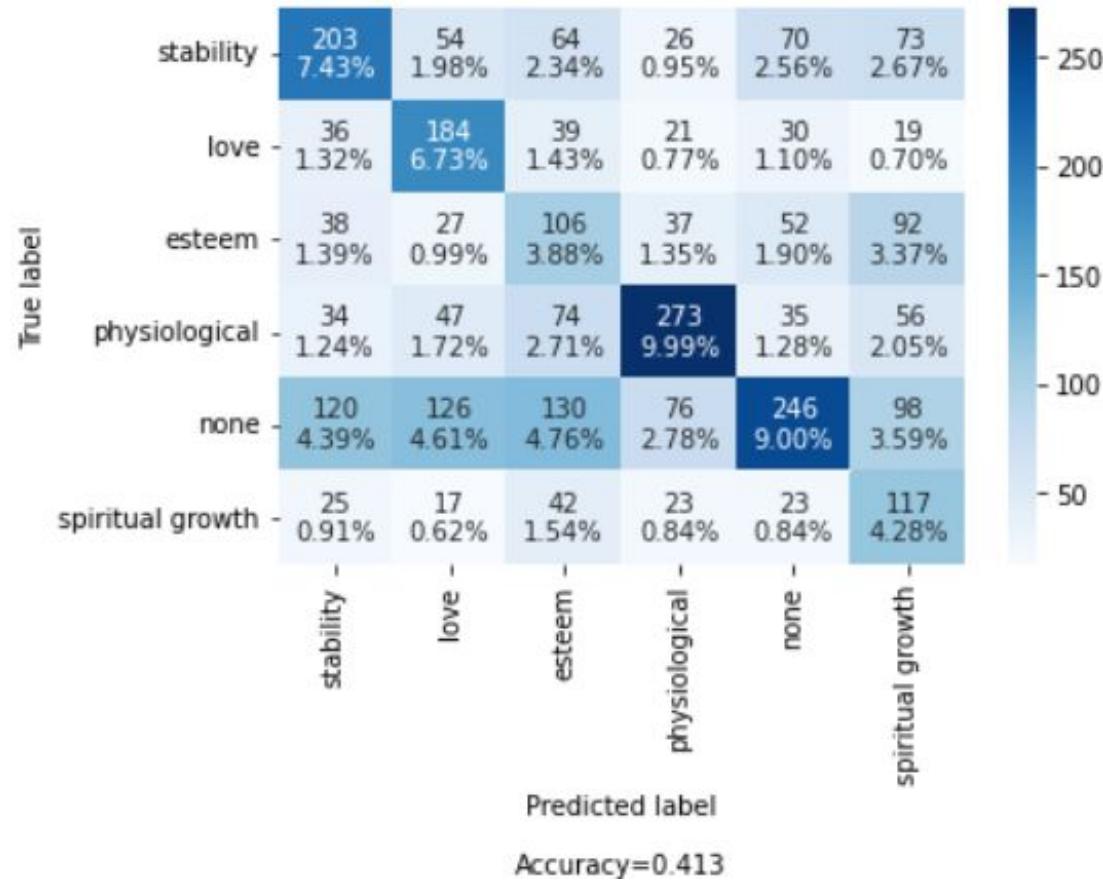
On Running upon 50 iterations: Time Taken For each Epoch: 275s  
(4.5min)

- Initial:
  - Loss: 1.7508 Val Accuracy: 0.3696
- Final:

# Uniform Classification: Overview

- ▶ On Running upon 50 iterations: Time Taken For each Epoch: 154s (2.5min)
  - ▶ Initial:
    - ▶ Loss: 1.6724 Val Accuracy: 0.3693
  - ▶ Final:
    - ▶ Loss: 1.5406 Val Accuracy: 0.4098

| sentence         |      |
|------------------|------|
| maslow           |      |
| esteem           | 2277 |
| love             | 2277 |
| none             | 2277 |
| physiological    | 2277 |
| spiritual growth | 2277 |
| stability        | 2277 |



# Developing BERT Model for 3 Classes Multi Classification Problem

# Defining advanced, basic and none needs.

Basic Needs : Sentences which are mapped to Maslow categories: [physiological ,love,stability] by annotators.

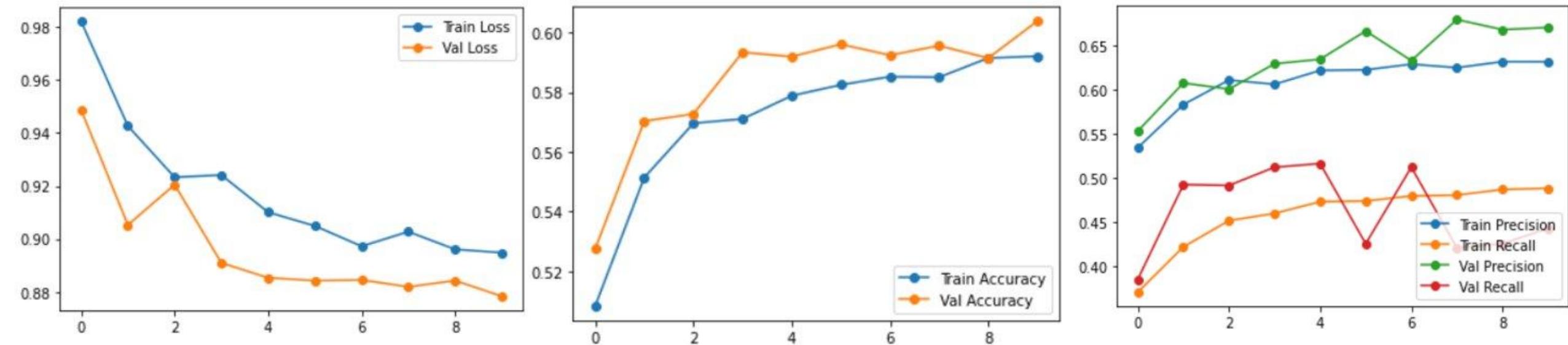
Advanced Needs: Sentences which are mapped to Maslow categories: [esteem,spiritual growth] by annotators.

None: Sentences which are mapped to Maslow category none by annotators.

# Overview

- ▶ On Running upon 10 iterations:  
Time Taken For each  
Epoch: 234s(3.9min)
- ▶ Initial:
  - ▶ Train Loss: 0.9821 Val  
Accuracy: 0.5276
- ▶ Final:
  - ▶ Loss: 0.8948 Val  
Accuracy: 0.6038

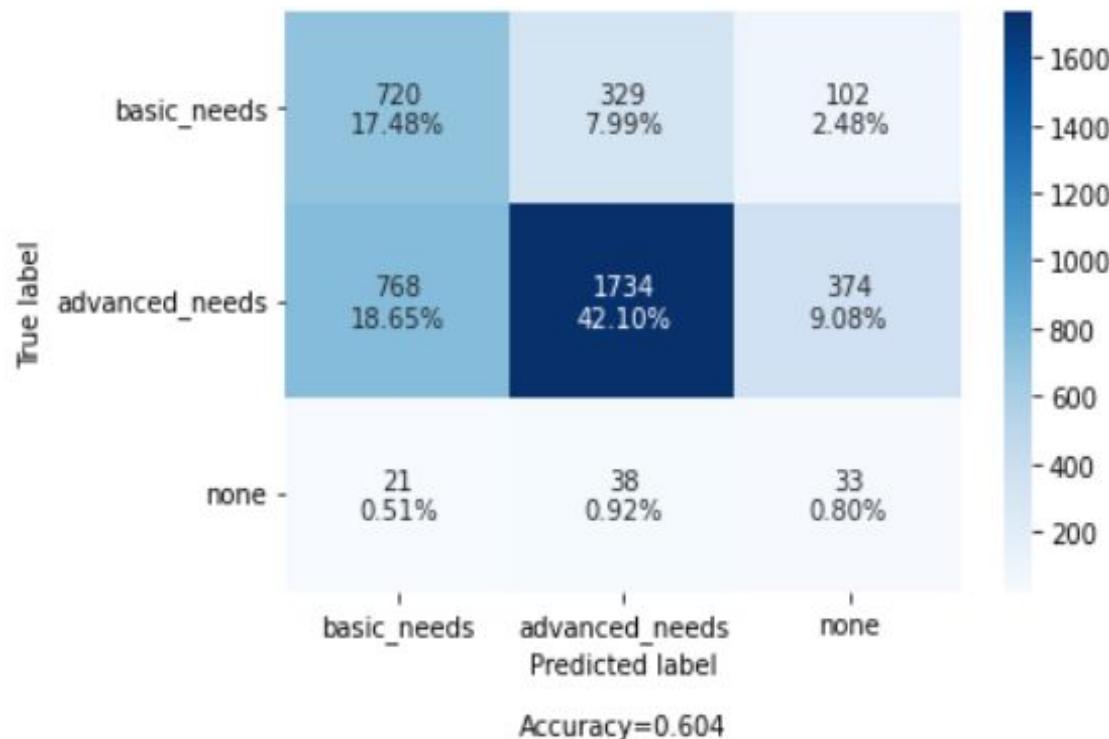
| maslow         | sentence |
|----------------|----------|
| advanced_needs | 7547     |
| basic_needs    | 10503    |
| none           | 2543     |



View of Accuracy, Loss, Precision and Recall

- ▶ Confusion Matrix and Classification Report

|                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.48      | 0.63   | 0.54     | 1151    |
| basic_needs    | 0.83      | 0.60   | 0.70     | 2876    |
| none           | 0.06      | 0.36   | 0.11     | 92      |
| accuracy       |           |        | 0.60     | 4119    |
| macro avg      | 0.46      | 0.53   | 0.45     | 4119    |
| weighted avg   | 0.71      | 0.60   | 0.64     | 4119    |

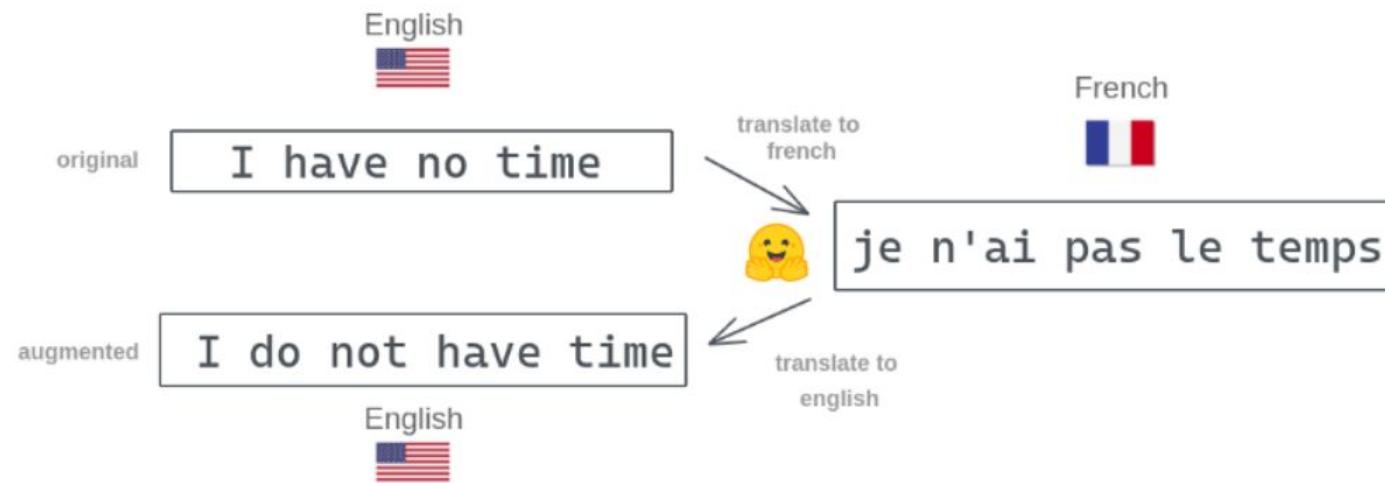


Error: Labels of Advanced and Basic Needs are Interchanged in Confusion Matrix

# Introducing Augmentations for Category None

Focusing on Back  
Translation

# Explaining Augmentation Method:



1. After referring to different methods for augmentation of data we found that Back Translation gave promising results for getting extra examples of text.
2. Therefore here we used data augmentation technique called "Back Translation". In this we take original text written in English.
3. Then convert into another language using MarianMT. We translate the translated text back to English using MarianMT.
4. We keep back translated English text if it is different from the original English sentence.

Referred Paper Link: <https://arxiv.org/pdf/2105.03075.pdf>

# Augmentations for None Category

| sentence         |      |
|------------------|------|
| maslow           |      |
| esteem           | 5187 |
| love             | 4502 |
| none             | 2543 |
| physiological    | 2277 |
| spiritual growth | 2360 |
| stability        | 3724 |



| sentence         |      |
|------------------|------|
| maslow           |      |
| esteem           | 5187 |
| love             | 4502 |
| none             | 4843 |
| physiological    | 2277 |
| spiritual growth | 2360 |
| stability        | 3724 |

| sentence       |       |
|----------------|-------|
| maslow         |       |
| advanced_needs | 7547  |
| basic_needs    | 10503 |
| none           | 2543  |

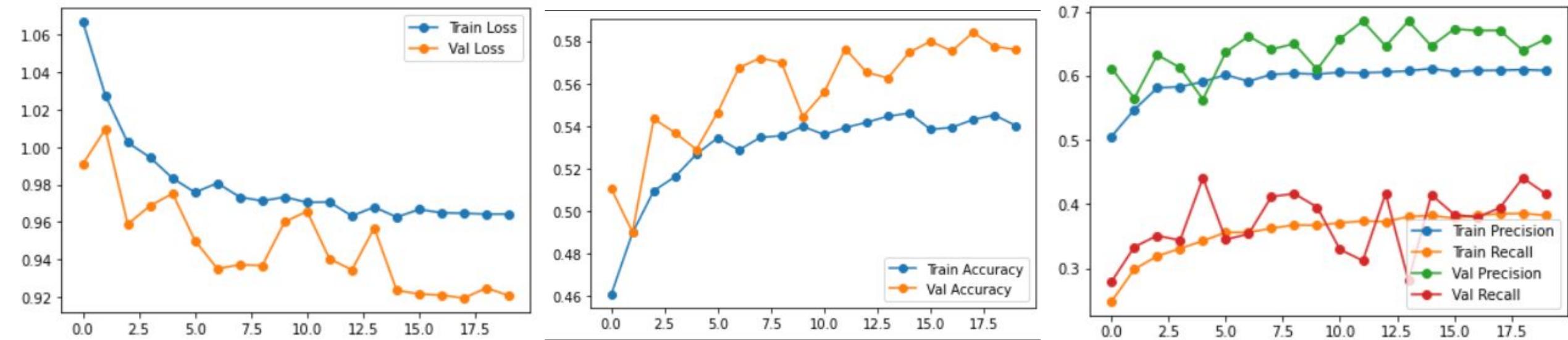


| sentence       |       |
|----------------|-------|
| maslow         |       |
| advanced_needs | 7547  |
| basic_needs    | 10503 |
| none           | 4843  |

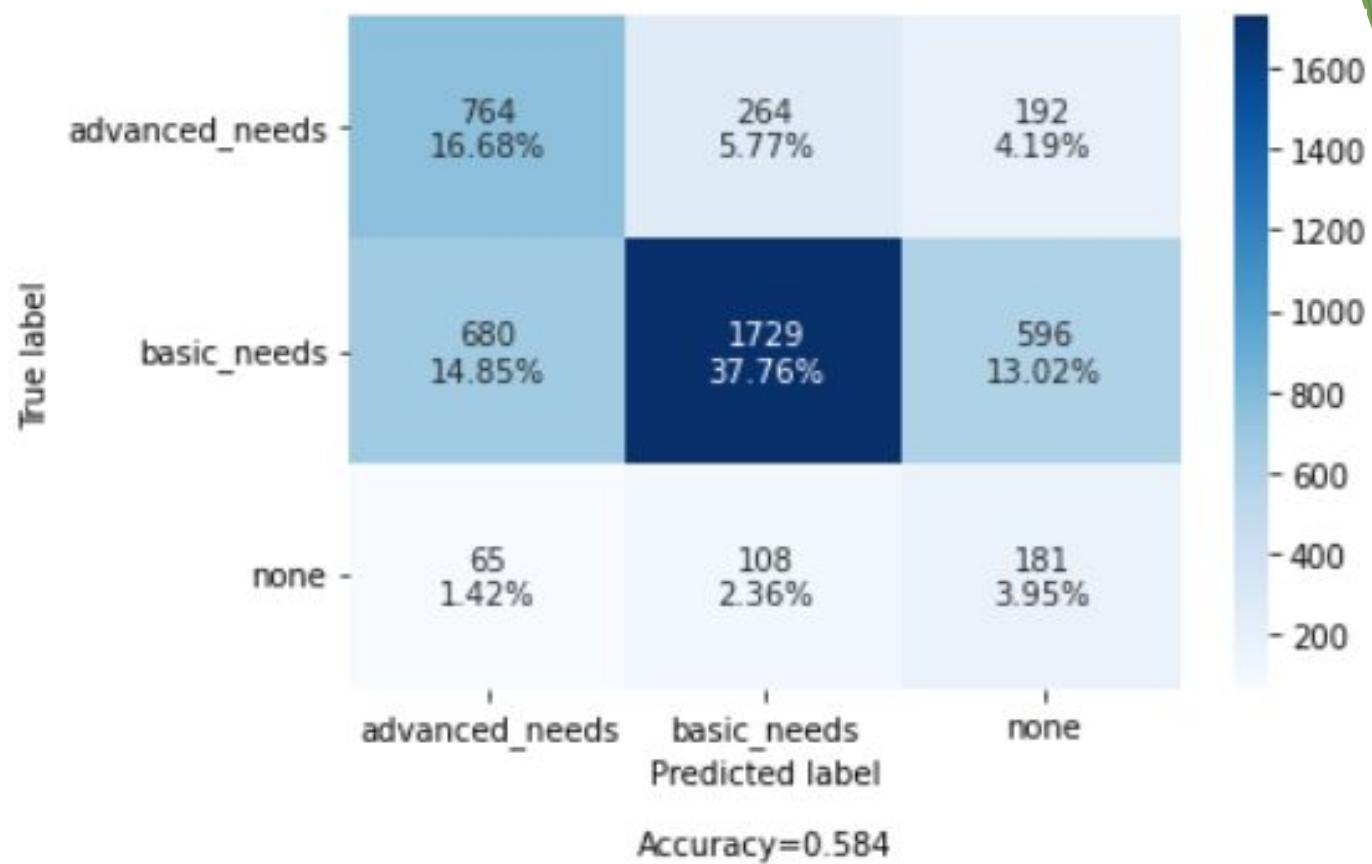
Augmentations from French added

# Training BERT Model

- On Running upon 20 iterations: Time Taken For each Epoch: 253s (4.2min)
  - Initial:
    - Loss: 1.0666 Val Accuracy: 0.5106
  - Final:
    - Loss: 0.9194 Val Accuracy: 0.5840



# Evaluation Analysis



|                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.48      | 0.63   | 0.54     | 1151    |
| basic_needs    | 0.83      | 0.60   | 0.70     | 2876    |
| none           | 0.06      | 0.36   | 0.11     | 92      |
| accuracy       |           |        | 0.60     | 4119    |
| macro avg      | 0.46      | 0.53   | 0.45     | 4119    |
| weighted avg   | 0.71      | 0.60   | 0.64     | 4119    |



|                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.51      | 0.63   | 0.56     | 1220    |
| basic_needs    | 0.82      | 0.58   | 0.68     | 3005    |
| none           | 0.19      | 0.51   | 0.27     | 354     |
| accuracy       |           |        | 0.58     | 4579    |
| macro avg      | 0.51      | 0.57   | 0.50     | 4579    |
| weighted avg   | 0.69      | 0.58   | 0.61     | 4579    |

# Things Done:

From 4th August - 9th August

More  
Augmentations to  
None via BT

# Augmentations for None Category

| sentence         |      |
|------------------|------|
| maslow           |      |
| esteem           | 5187 |
| love             | 4502 |
| none             | 2543 |
| physiological    | 2277 |
| spiritual growth | 2360 |
| stability        | 3724 |



| sentence         |      |
|------------------|------|
| maslow           |      |
| esteem           | 5187 |
| love             | 4502 |
| none             | 6908 |
| physiological    | 2277 |
| spiritual growth | 2360 |
| stability        | 3724 |

| sentence       |       |
|----------------|-------|
| maslow         |       |
| advanced_needs | 7547  |
| basic_needs    | 10503 |
| none           | 2543  |

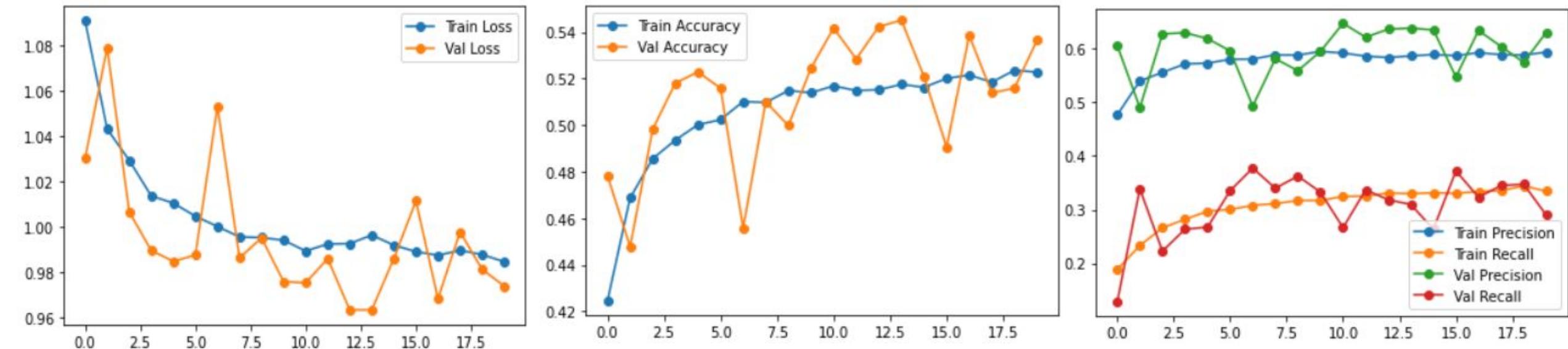


| sentence       |       |
|----------------|-------|
| maslow         |       |
| advanced_needs | 7547  |
| basic_needs    | 10503 |
| none           | 6908  |

Augmentations from French + Spanish added

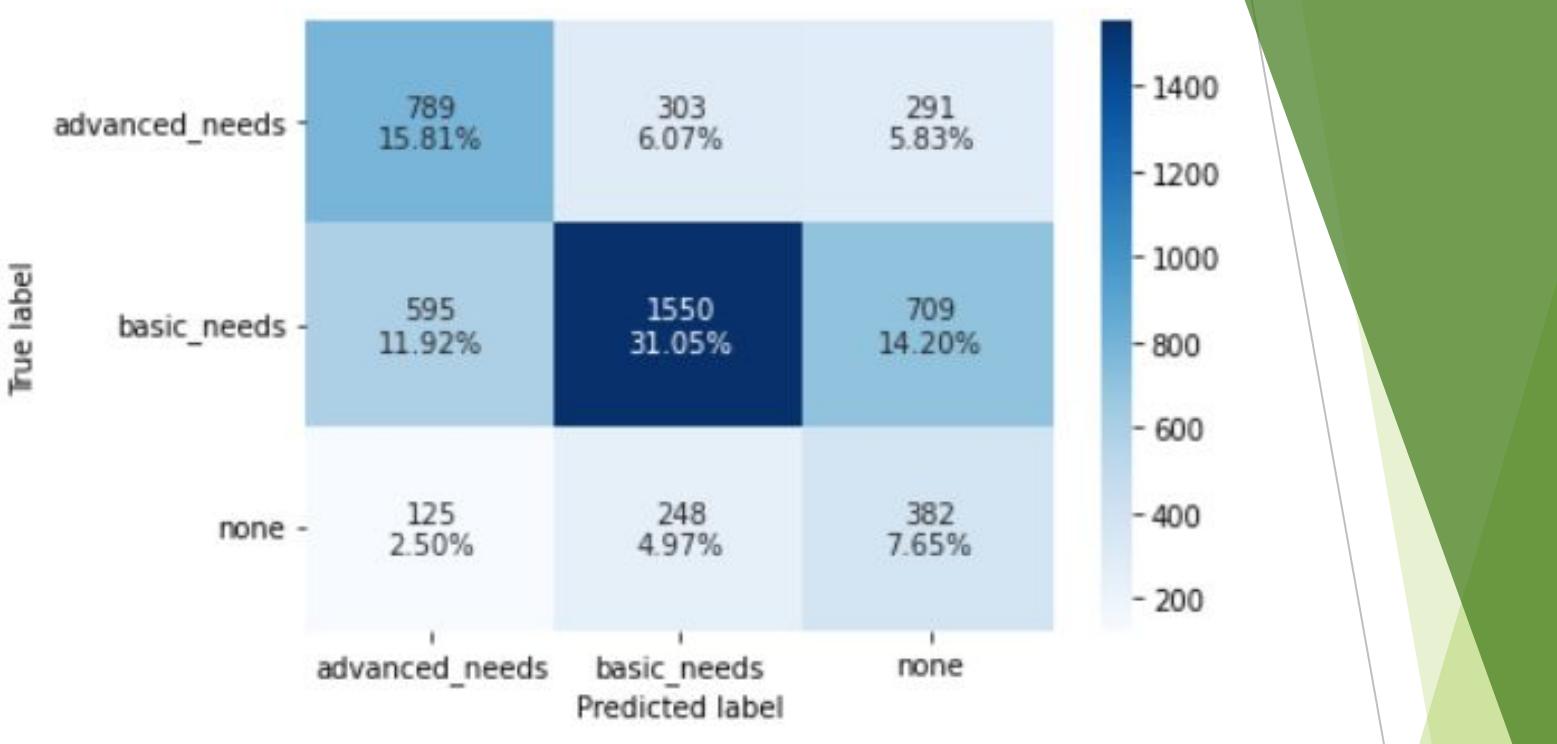
# Training BERT Model

- ▶ On Running upon 20 iterations: Time Taken For each Epoch: 278s (4.6min)
- ▶ Initial:
  - ▶ Loss: 1.0909 Val Accuracy: 0.4782
- ▶ Final:
  - ▶ Loss: 0.9631 Val Accuracy: 0.5451



# Evaluation Analysis

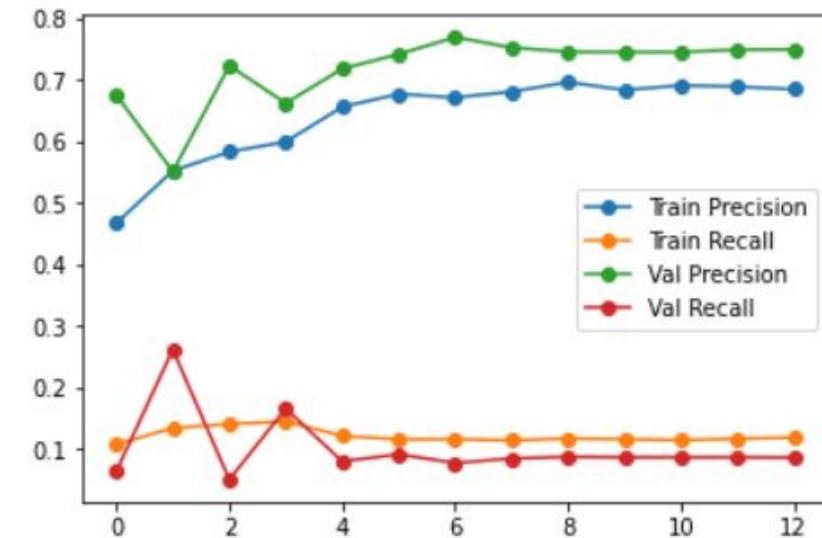
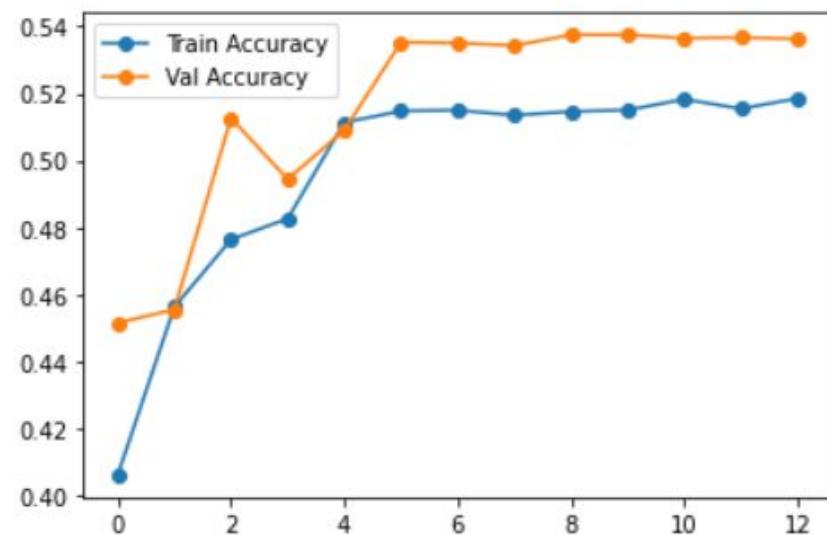
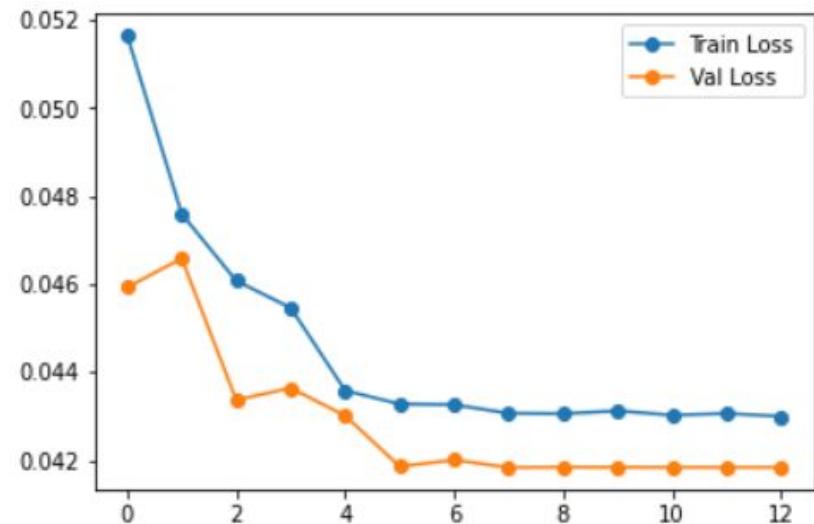
|                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.51      | 0.63   | 0.56     | 1220    |
| basic_needs    | 0.82      | 0.58   | 0.68     | 3005    |
| none           | 0.19      | 0.51   | 0.27     | 354     |
| accuracy       |           |        | 0.58     | 4579    |
| macro avg      | 0.51      | 0.57   | 0.50     | 4579    |
| weighted avg   | 0.69      | 0.58   | 0.61     | 4579    |



|                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.52      | 0.57   | 0.55     | 1383    |
| basic_needs    | 0.74      | 0.54   | 0.63     | 2854    |
| none           | 0.28      | 0.51   | 0.36     | 755     |
| accuracy       |           |        | 0.55     | 4992    |
| macro avg      | 0.51      | 0.54   | 0.51     | 4992    |
| weighted avg   | 0.61      | 0.55   | 0.56     | 4992    |

# Introducing Focal Loss as Loss Function

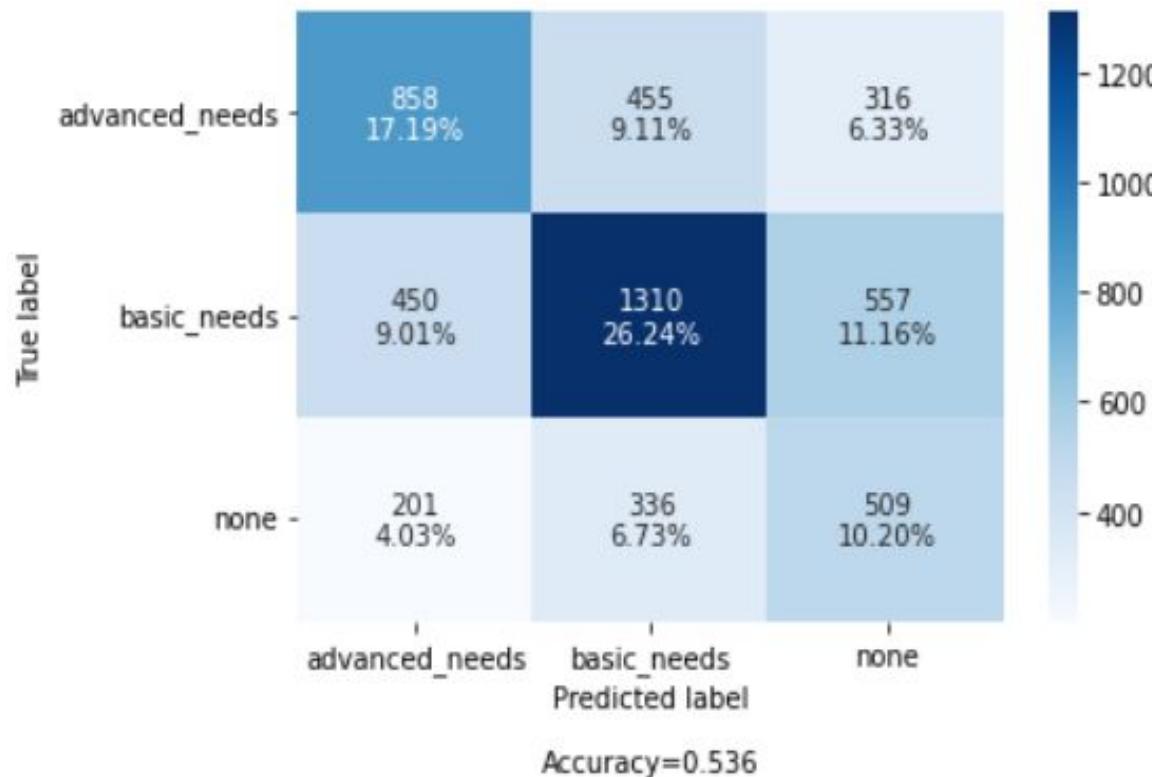
Along with Augmented  
Dataset



With Focal Loss as Loss Function + Augmented None Data(French + Spanish)

- On Running upon 13 iterations(Early Stopping): Time Taken For each Epoch: 282s (4.7min)
  - Initial:
    - Loss: 0.0516 Val Accuracy: 0.4515
  - Final:
    - Loss: 0.0418 Val Accuracy: 0.5375

# Evaluation Analysis



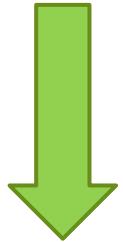
|                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.52      | 0.57   | 0.55     | 1383    |
| basic_needs    | 0.74      | 0.54   | 0.63     | 2854    |
| none           | 0.28      | 0.51   | 0.36     | 755     |
| accuracy       |           |        | 0.55     | 4992    |
| macro avg      | 0.51      | 0.54   | 0.51     | 4992    |
| weighted avg   | 0.61      | 0.55   | 0.56     | 4992    |



|                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.44      | 0.58   | 0.50     | 1133    |
| basic_needs    | 0.76      | 0.53   | 0.63     | 2989    |
| none           | 0.31      | 0.49   | 0.38     | 870     |
| accuracy       |           |        | 0.54     | 4992    |
| macro avg      | 0.50      | 0.54   | 0.50     | 4992    |
| weighted avg   | 0.61      | 0.54   | 0.56     | 4992    |

# Change in Model Architecture

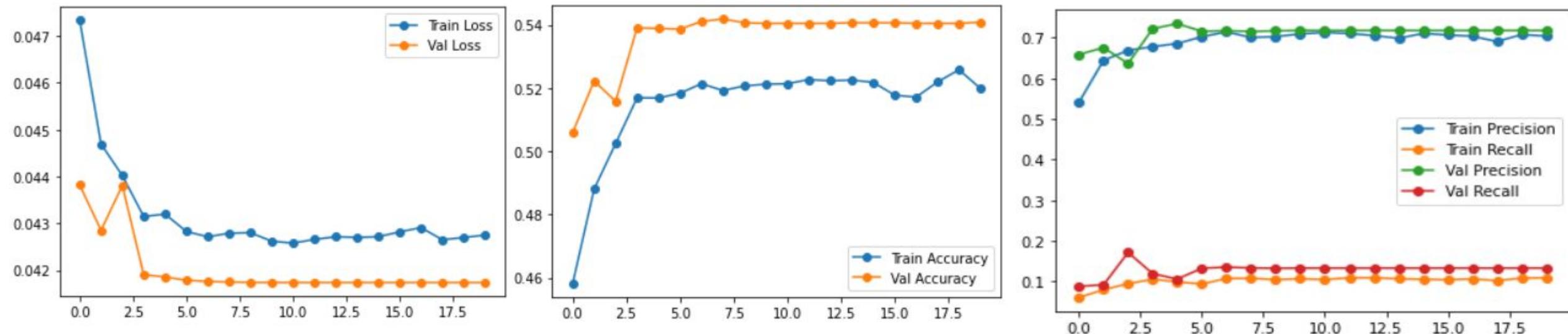
```
text_input = tf.keras.layers.Input(shape=(), dtype=tf.string, name='text')
preprocessed_text = bert_preprocess(text_input)
outputs = bert_encoder(preprocessed_text)
l = tf.keras.layers.Dropout(0.1, name="dropout")(outputs['pooled_output'])
l = tf.keras.layers.Dense(3, activation='softmax', name="output")(l)
```



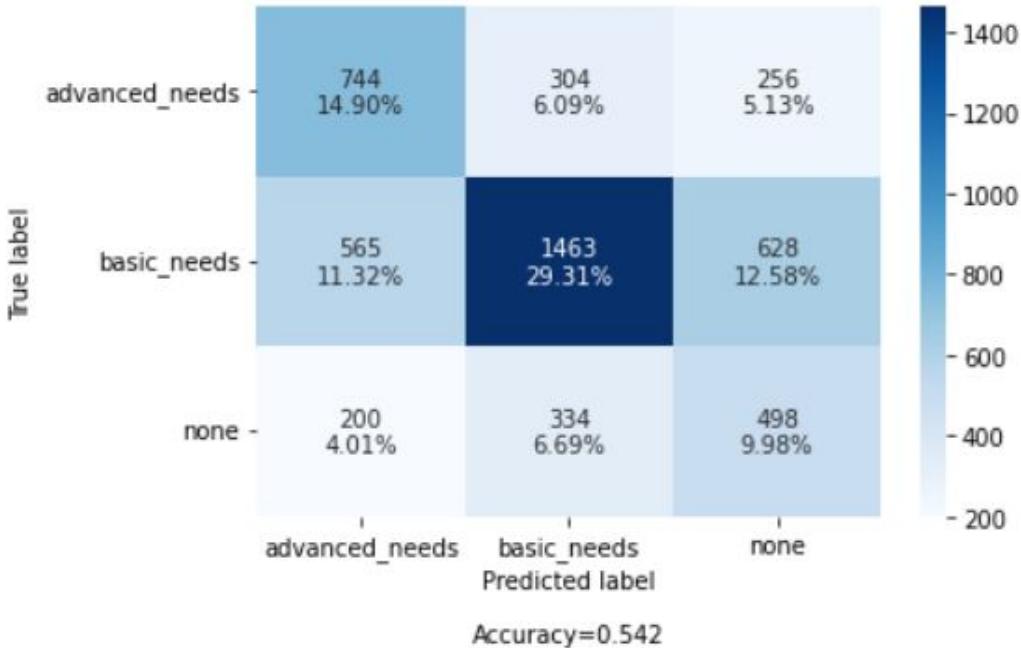
```
text_input = tf.keras.layers.Input(shape=(), dtype=tf.string, name='text')
preprocessed_text = bert_preprocess(text_input)
outputs = bert_encoder(preprocessed_text)
l = tf.keras.layers.Dropout(0.1, name="dropout")(outputs['pooled_output'])
l = tf.keras.layers.Dense(40, activation = 'relu', name = 'layer1')(l)
l = tf.keras.layers.BatchNormalization()(l, training= True)
l = tf.keras.layers.Dense(40, activation = None, name = 'layer2')(l)
l = tf.keras.layers.Dense(3, activation='softmax', name="output")(l)
```

# Training with BERT

- On Running upon 20 iterations(Early Stopping): Time Taken For each Epoch: 199s (3.31min)
- Initial:
  - Loss: 0.0473 Val Accuracy: 0.5060
  - Loss: 0.0428 Val Accuracy: 0.5419



# Evaluation Analysis



|                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.44      | 0.58   | 0.50     | 1133    |
| basic_needs    | 0.76      | 0.53   | 0.63     | 2989    |
| none           | 0.31      | 0.49   | 0.38     | 870     |
| accuracy       |           |        | 0.54     | 4992    |
| macro avg      | 0.50      | 0.54   | 0.50     | 4992    |
| weighted avg   | 0.61      | 0.54   | 0.56     | 4992    |

|                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.49      | 0.57   | 0.53     | 1304    |
| basic_needs    | 0.70      | 0.55   | 0.62     | 2656    |
| none           | 0.36      | 0.48   | 0.41     | 1032    |
| accuracy       |           |        | 0.54     | 4992    |
| macro avg      | 0.52      | 0.53   | 0.52     | 4992    |
| weighted avg   | 0.57      | 0.54   | 0.55     | 4992    |

# Adding More Layers and Fine Tuning

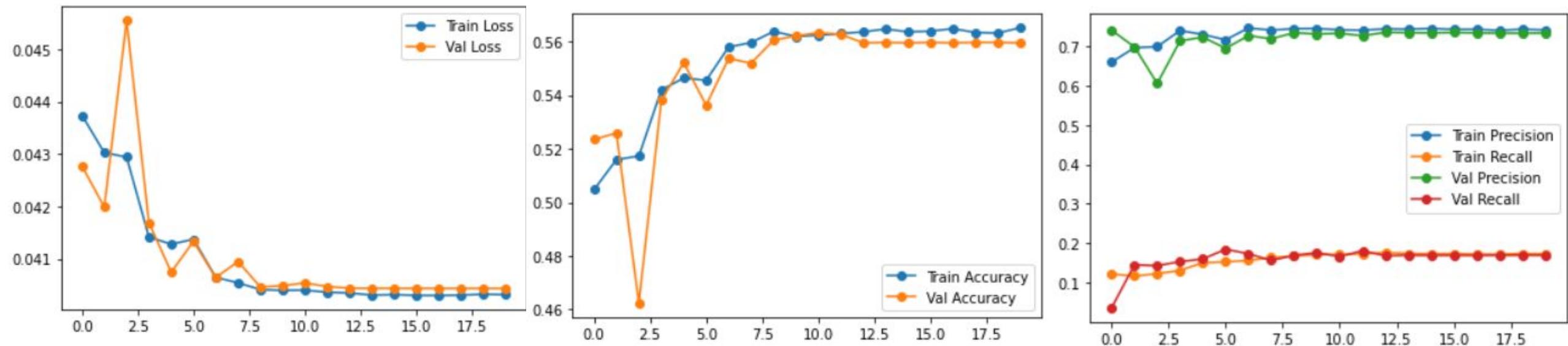
```
text_input = tf.keras.layers.Input(shape=(), dtype=tf.string, name='text')
preprocessed_text = bert_preprocess(text_input)
outputs = bert_encoder(preprocessed_text)
l = tf.keras.layers.Dropout(0.1, name="dropout")(outputs['pooled_output'])
l = tf.keras.layers.Dense(40, activation = 'relu', name = 'layer1')(l)
l = tf.keras.layers.BatchNormalization()(l, training= True)
l = tf.keras.layers.Dense(40, activation = None, name = 'layer2')(l)
l = tf.keras.layers.Dense(3, activation='softmax', name="output")(l)
```



```
text_input = tf.keras.layers.Input(shape=(), dtype=tf.string, name='text')
preprocessed_text = bert_preprocess(text_input)
outputs = bert_encoder(preprocessed_text)
l = tf.keras.layers.Dropout(hp.Choice('drop_number_1',[0.01,0.001,0.2,0.3,0.1]), name="dropout")(outputs['pooled_output'])
l = tf.keras.layers.Dense(units = 128, activation = 'relu', name = 'layer1')(l)
l = tf.keras.layers.BatchNormalization()(l, training= True)
l = tf.keras.layers.Dropout(hp.Choice('drop_number_2',[0.01,0.001,0.2,0.3,0.1]), name="dropout")(outputs['pooled_output'])
l = tf.keras.layers.Dense(units = 128, activation = None, name = 'layer2')(l)
l = tf.keras.layers.BatchNormalization()(l, training= True)
l = tf.keras.layers.Dropout(hp.Choice('drop_number_3',[0.01,0.001,0.2,0.3,0.1]), name="dropout")(outputs['pooled_output'])
l = tf.keras.layers.Dense(units = 128, activation = None, name = 'layer3')(l)
l = tf.keras.layers.Dense(3, activation='softmax', name="output")(l)
model = tf.keras.Model(inputs=[text_input], outputs = [l])
model.compile(loss= focal_loss(alpha=0.1, gamma = 2) , optimizer='adam', metrics=METRICS)
```

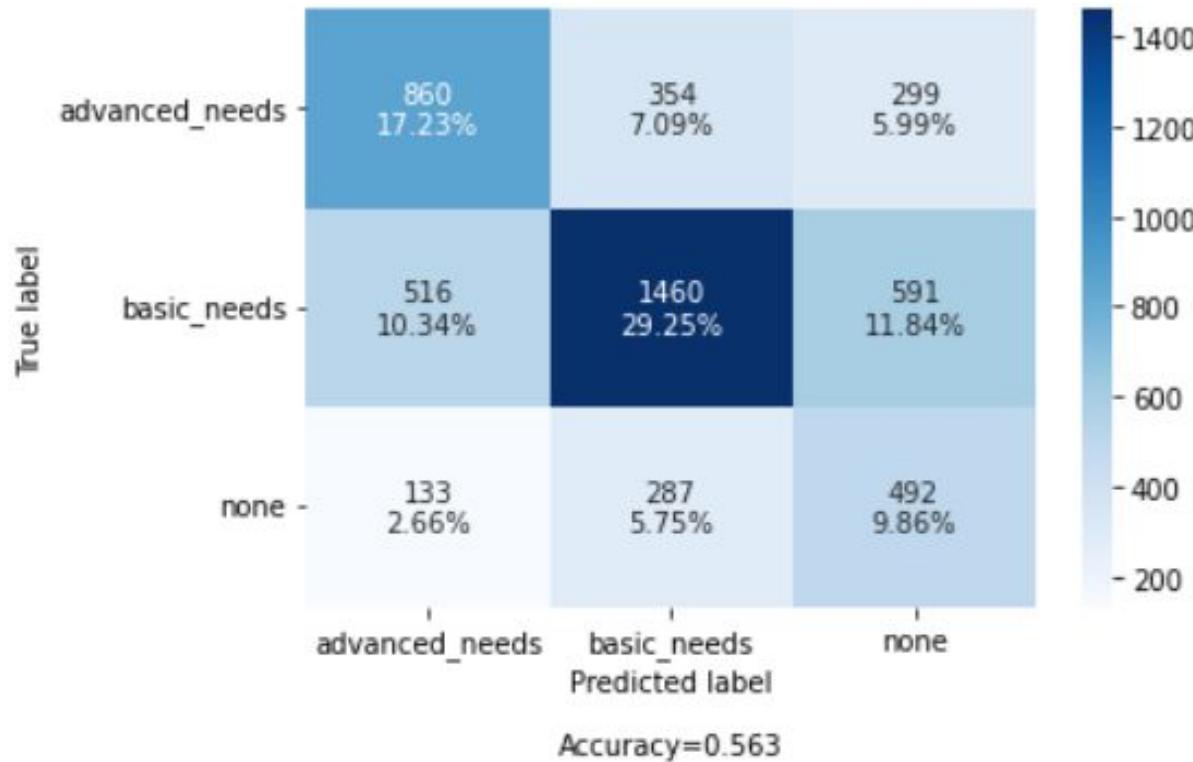
# Training Bert

- On Running upon 50 iterations: Time Taken For each Epoch: 190s (3.1min)
  - Initial:
    - Loss: 0.0437 Val Accuracy: 0.5234
  - Final:
    - Loss: 0.0405 Val Accuracy: 0.5633



# Evaluation Analysis

Best Avg F1  
Score = 0.54



Comparison of model performance metrics:

|                | precision | recall | f1-score | support |                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.49      | 0.57   | 0.53     | 1304    | advanced_needs | 0.57      | 0.57   | 0.57     | 1513    |
| basic_needs    | 0.70      | 0.55   | 0.62     | 2656    | basic_needs    | 0.69      | 0.57   | 0.63     | 2567    |
| none           | 0.36      | 0.48   | 0.41     | 1032    | none           | 0.36      | 0.54   | 0.43     | 912     |
| accuracy       |           |        | 0.54     | 4992    | accuracy       |           |        | 0.56     | 4992    |
| macro avg      | 0.52      | 0.53   | 0.52     | 4992    | macro avg      | 0.54      | 0.56   | 0.54     | 4992    |
| weighted avg   | 0.57      | 0.54   | 0.55     | 4992    | weighted avg   | 0.60      | 0.56   | 0.57     | 4992    |

# Working with Different Models with Common Architecture

```
text_input = tf.keras.layers.Input(shape=(), dtype=tf.string, name='text')
preprocessed_text = bert_preprocess(text_input)
outputs = bert_encoder(preprocessed_text)
l = tf.keras.layers.Dropout(0.1, name="dropout1")(outputs['pooled_output'])
l = tf.keras.layers.Dense(units = 128, activation = 'relu',name = 'layer1')(l)
l = tf.keras.layers.BatchNormalization()(l, training= True)
l = tf.keras.layers.Dropout(0.1, name="dropout2")(l)
l = tf.keras.layers.Dense(units = 128, activation = 'relu',,name = 'layer2')(l)
l = tf.keras.layers.BatchNormalization()(l, training= True)
l = tf.keras.layers.Dropout(0.001,name="dropout3")(l)
l = tf.keras.layers.Dense(units = 128, activation = 'relu',name = 'layer3')(l)
l = tf.keras.layers.Dense(3, activation='softmax', name="output")(l)
model = tf.keras.Model(inputs=[text_input], outputs = [l])
model.compile(loss= focal_loss(alpha=0.1, gamma = 2) , optimizer='adam' , metrics=METRICS)
history = model.fit(x_train, y_train,epochs=20, verbose=1, validation_data = (x_test,y_test),
                     batch_size  = 8,callbacks=[model_checkpoint_callback,callback, reduce_lr])
```

# Comparison between different Models

## Performance:

| Model                                      | Accuracy | Advanced Needs F1 | Basic Needs F1 | None F1 | Macro Avg F1 |
|--|----------|-------------------|----------------|---------|--------------|
| bert_en_uncased_L-12_H-768_A-12/4          | 0.55     | 0.56              | 0.62           | 0.42    | 0.53         |
| small_bert/bert_en_uncased_L-2_H-768_A-12  | 0.55     | 0.56              | 0.62           | 0.41    | 0.53         |
| small_bert/bert_en_uncased_L-4_H-768_A-12  | 0.58     | 0.59              | 0.64           | 0.47    | 0.56         |
| small_bert/bert_en_uncased_L-6_H-768_A-12  | 0.57     | 0.57              | 0.63           | 0.46    | 0.55         |
| small_bert/bert_en_uncased_L-8_H-768_A-12  | 0.56     | 0.57              | 0.62           | 0.41    | 0.53         |
| albert_en_base                             | 0.54     | 0.5               | 0.61           | 0.4     | 0.51         |
| small_bert/bert_en_uncased_L-10_H-768_A-12 | 0.57     | 0.55              | 0.64           | 0.45    | 0.55         |
| small_bert/bert_en_uncased_L-12_H-768_A-12 | 0.57     | 0.54              | 0.64           | 0.47    | 0.55         |
| electra_small                              | 0.51     | 0.39              | 0.6            | 0.42    | 0.47         |
| experts_pubmed                             | 0.54     | 0.5               | 0.61           | 0.44    | 0.52         |
| experts_wiki_books                         | 0.52     | 0.5               | 0.61           | 0.36    | 0.49         |
| talking-heads_base                         | 0.56     | 0.52              | 0.63           | 0.47    | 0.54         |

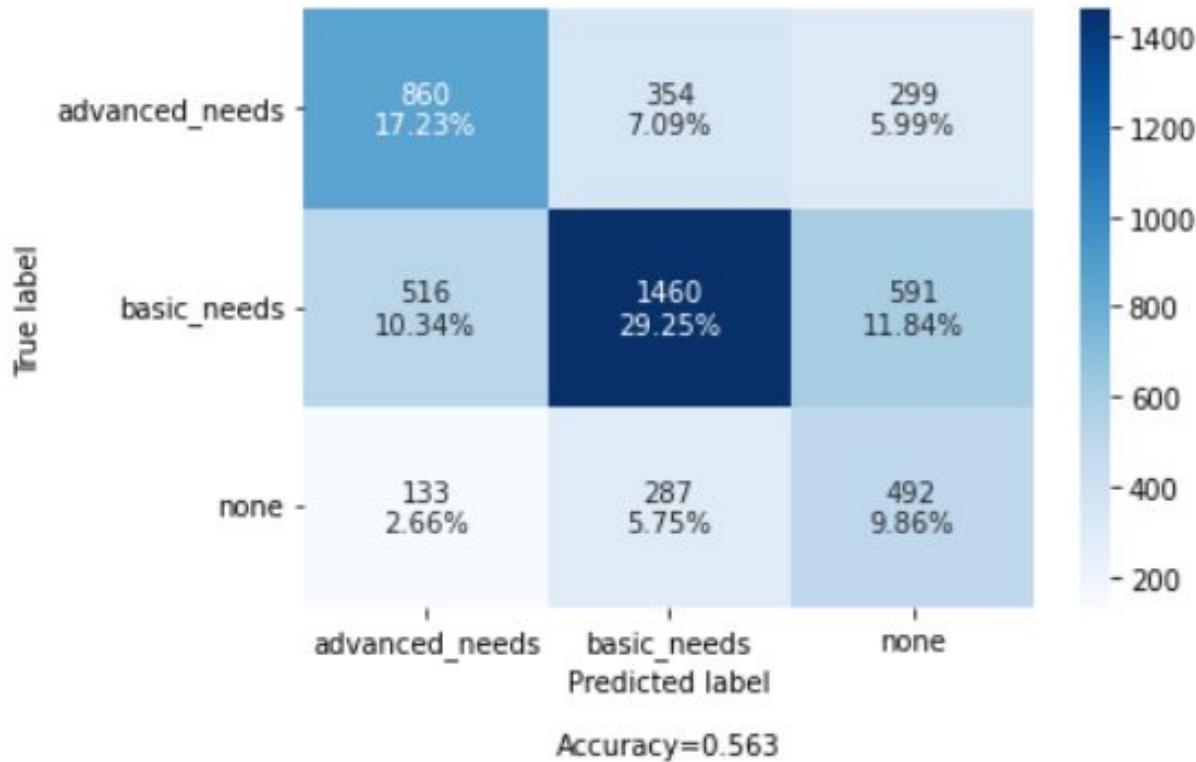
| Model                                      | Accuracy | Advanced Needs F1 | Basic Needs F1 | None F1 | Macro Avg F1 |
|--|----------|-------------------|----------------|---------|--------------|
| bert_en_uncased_L-12_H-768_A-12/4          | 0.55     | 0.56              | 0.62           | 0.42    | 0.53         |
| small_bert/bert_en_uncased_L-2_H-768_A-12  | 0.55     | 0.56              | 0.62           | 0.41    | 0.53         |
| small_bert/bert_en_uncased_L-4_H-768_A-12  | 0.57     | 0.59              | 0.64           | 0.47    | 0.56         |
| small_bert/bert_en_uncased_L-6_H-768_A-12  | 0.57     | 0.57              | 0.63           | 0.46    | 0.55         |
| small_bert/bert_en_uncased_L-8_H-768_A-12  | 0.56     | 0.57              | 0.62           | 0.41    | 0.53         |
| albert_en_base                             | 0.54     | 0.5               | 0.61           | 0.4     | 0.51         |
| small_bert/bert_en_uncased_L-10_H-768_A-12 | 0.57     | 0.55              | 0.64           | 0.45    | 0.55         |
| small_bert/bert_en_uncased_L-12_H-768_A-12 | 0.57     | 0.54              | 0.64           | 0.47    | 0.55         |
| electra_small                              | 0.51     | 0.39              | 0.6            | 0.42    | 0.47         |
| experts_pubmed                             | 0.54     | 0.5               | 0.61           | 0.44    | 0.52         |
| experts_wiki_books                         | 0.52     | 0.5               | 0.61           | 0.36    | 0.49         |
| talking-heads_base                         | 0.56     | 0.52              | 0.63           | 0.47    | 0.54         |

# Things Done:

From 10th August - 17th  
August

# Evaluation Analysis

Best Avg F1  
Score = 0.54



Comparison of model performance metrics:

|                | precision | recall | f1-score | support |                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.49      | 0.57   | 0.53     | 1304    | advanced_needs | 0.57      | 0.57   | 0.57     | 1513    |
| basic_needs    | 0.70      | 0.55   | 0.62     | 2656    | basic_needs    | 0.69      | 0.57   | 0.63     | 2567    |
| none           | 0.36      | 0.48   | 0.41     | 1032    | none           | 0.36      | 0.54   | 0.43     | 912     |
| accuracy       |           |        | 0.54     | 4992    | accuracy       |           |        | 0.56     | 4992    |
| macro avg      | 0.52      | 0.53   | 0.52     | 4992    | macro avg      | 0.54      | 0.56   | 0.54     | 4992    |
| weighted avg   | 0.57      | 0.54   | 0.55     | 4992    | weighted avg   | 0.60      | 0.56   | 0.57     | 4992    |

# Model trained after hyperparameter tuning:

```
text_input = tf.keras.layers.Input(shape=(), dtype=tf.string, name='text')
preprocessed_text = bert_preprocess(text_input)
outputs = bert_encoder(preprocessed_text)
l = tf.keras.layers.Dropout(hp.Choice('drop_number_1',[0.7,0.8,0.6]), name="dropout1")(outputs['pooled_output'])
l = tf.keras.layers.Dense(units = 128, activation = 'relu', kernel_initializer = 'he_uniform',name = 'layer1')(l)
l = tf.keras.layers.BatchNormalization()(l, training= True)

l = tf.keras.layers.Dropout(hp.Choice('drop_number_2',[0.5,0.6,0.7,0.8,0.9]), name="dropout2")(l)
l = tf.keras.layers.Dense(units = 128, activation = None, kernel_initializer = 'he_uniform',name = 'layer2')(l)
l = tf.keras.layers.BatchNormalization()(l, training= True)

l = tf.keras.layers.Dropout(hp.Choice('drop_number_3',[0.5, 0.6, 0.7, 0.8, 0.9]), name="dropout3")(l)
l = tf.keras.layers.Dense(units = 128, activation = None, kernel_initializer = 'he_uniform',name = 'layer3')(l)
l = tf.keras.layers.Dense(3, activation='softmax', name="output")(l)
model = tf.keras.Model(inputs=[text_input], outputs = [l])
model.compile(loss= focal_loss(alpha=0.1, gamma = 2) , optimizer='adam' , metrics=METRICS)
```

Best Parameters:

Dropout Number 1: 0.6

Dropout Number 2: 0.5

Dropout Number 3: 0.6

# Datasets

Test Set

| sentence         |      |
|------------------|------|
| maslow           |      |
| esteem           | 1038 |
| love             | 900  |
| none             | 509  |
| physiological    | 455  |
| spiritual growth | 472  |
| stability        | 745  |

Original Dataset

| sentence         |      |
|------------------|------|
| maslow           |      |
| esteem           | 5187 |
| love             | 4502 |
| none             | 2543 |
| physiological    | 2277 |
| spiritual growth | 2360 |
| stability        | 3724 |

Train Set

| sentence         |      |
|------------------|------|
| maslow           |      |
| esteem           | 4149 |
| love             | 3602 |
| none             | 2034 |
| physiological    | 1822 |
| spiritual growth | 1888 |
| stability        | 2979 |

| sentence       |      |
|----------------|------|
| maslow         |      |
| advanced_needs | 6037 |
| basic_needs    | 8403 |
| none           | 2034 |

# After Augmentations

Train Set

| sentence         |      |
|------------------|------|
| maslow           |      |
| esteem           | 4149 |
| love             | 3602 |
| none             | 2034 |
| physiological    | 1822 |
| spiritual growth | 1888 |
| stability        | 2979 |

Train Set

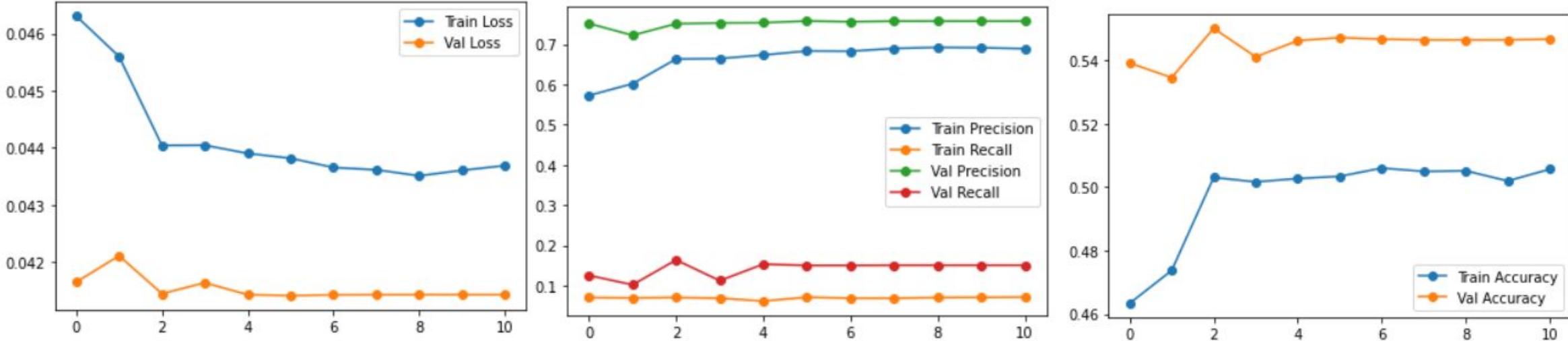
| sentence         |      |
|------------------|------|
| maslow           |      |
| esteem           | 4149 |
| love             | 3602 |
| none             | 5528 |
| physiological    | 1822 |
| spiritual growth | 1888 |
| stability        | 2979 |

| sentence       |      |
|----------------|------|
| maslow         |      |
| advanced_needs | 6037 |
| basic_needs    | 8403 |
| none           | 2034 |



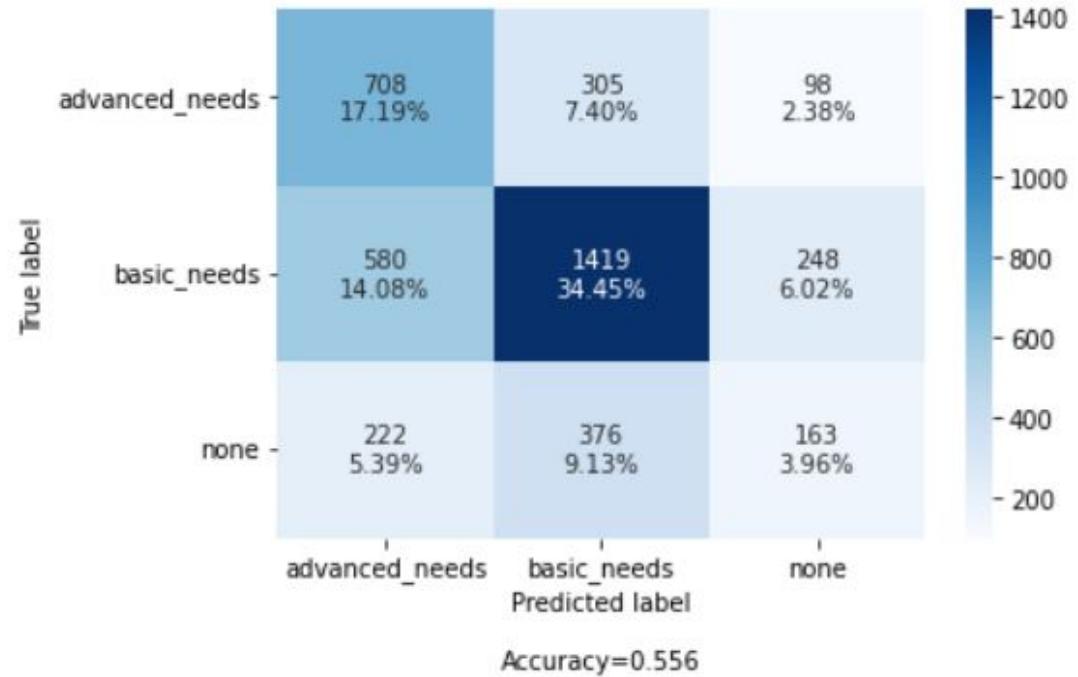
# Training BERT Model

UNC: 12082022\_1



- On Running upon 20 iterations: Time Taken For each Epoch: 104s (1.7min)
- Initial:
  - Loss: 0.0463 Val Accuracy: 0.5392
- Final:
  - Loss: 0.0408 Val Accuracy: 0.5560
  - Also the graph tells that Model finds it easier to predict on test set than prediction on train set.

# Evaluation Analysis



|                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.47      | 0.64   | 0.54     | 1111    |
| basic_needs    | 0.68      | 0.63   | 0.65     | 2247    |
| none           | 0.32      | 0.21   | 0.26     | 761     |
| accuracy       |           |        | 0.56     | 4119    |
| macro avg      | 0.49      | 0.49   | 0.48     | 4119    |
| weighted avg   | 0.55      | 0.56   | 0.55     | 4119    |

# Few wrongly Classified Samples

Text classified as basic\_needs but actual category is none

0 Tia was never good with dates.  
1 Paul wanted to go to the beach.  
22 Tom wanted to go to the bank to apply for a loan.  
28 Lloyd was out partying one night.He was having a great time.He was also drinking a little too much.  
29 It was a cold winter day and Tom didn't have anything to eat.  
37 Tim gave me a shirt for my birthday.I thought the shirt was very ugly and not my style.Mary's birthday was coming up next month.I put the shirt back in the closet.  
117 Mitch is playing basketball.Mitch driving to the hoop to make a dunk.He falls and hits his head on the floor.He is rushed to the hospital.Mitch gets stitches for his injury.  
123 Tim wanted to go on a vacation.She searched for good deals on flights everyday.Eventually she found a great deal.She booked tickets to the Bahama's.  
180 Monday was making fudge with her son.It was the holidays, the perfect time for fudge.She was stirring and stirring the hot fudge.She then slipped and threw the pan of hot fudge into the air.The fudge landed on a plate of cookies covering them all.  
189 Sarah was afraid of swimming underwater.Her friends were all going snorkeling on Saturday.

Text classified as basic\_needs but actual category is advanced\_needs

0 Jamie's job requires her to travel a lot.She has no family of her own so she doesn't mind.Her friends feel sorry for her.They think at her age she should have a family and offered to take her time with it and just be happy.  
17 To April,Billy was going overboard.  
26 Carrie had met a cute guy at the bar.she had given him her phone number when he asked.He promised to text her the next morning.When Carrie woke up she realized she had given him the wrong number.  
33 May and Charles were going shopping for an engagement ring.they went to the mall and visited Kay Jewelers.they saw many rings within their price range.  
38 A carnival was coming to town.Dalton loved to ride the ferris wheel.Dalton's mother warned him not to eat before getting on the ride.Dalton ate lots of carnival food that night.Dalton got sick on the ride.  
40 Jerry wanted to catch a fish.Jerry had a fishing pole and a bucket of bait, but one snapped his pole in half.Jerry went to the store to buy a new fishing pole.Jerry came home with two because he couldn't decide.  
52 Ed was a fisherman.  
53 Jack wanted to throw a dinner party.He went shopping for the food he would cook.Jake told the butcher he wanted to purchase veal.  
77 Roda was excited to do the morning announcements.She had never had much responsibility before.When she started to talk she was a bit nervous.She stood behind the podium and did her best words.Eventually she got more comfortable and did a good job.  
83 Alex was on a camping trip.

Text classified as advanced\_needs but actual category is basic\_needs

12 It was the year 2000 and everyone around the world celebrated the millennium every day.

12 It was the year coming up to the millennium and Cody was scared.Everyone was saying it was the end of the world and technology.So to keep his mind off of it Cody played Pokmon Blue on his gameboy.

13 Dennis was a comic book collector.

17 Lisa had a job interview in three days.She was nervous and unprepared.Lisa decided to study for the interview.She practiced for nine hours every day.

29 One day in 1982 my cousin called me.She works for a state agency.She told me she heard her agency was hiring.I scoffed at her, as the agency was very popular.I thought I might get a job.

30 Ed and Jerry wanted to go to the beach together.They immediately fell in love.

34 Kyle wanted to make an omelette for breakfast.He had four eggs left..He knew he could make a small omelette with two eggs.He could also make a big omelette with all four eggs but he didn't want to waste any eggs.

60 Margery was making toast with butter.Then she realized she was out of butter.she decided to use margarine instead.Then Margery realized something was wrong with the margarine.

65 Kate needed a new hat.she decided to make her own.she gathered the materials and she found a tutorial.

68 Conrad enjoyed writing stories.One morning,Conrad discovered he could be paid to write stories!Conrad spent the entire day writing fantastic tall tales.

Text classified as advanced\_needs but actual category is none

13 Fred was a high school student at a small school.

1988 Fred was born in a small town in the United States.School was hard for him because he knew no english.

Text classified as none but actual category is basic\_needs

2 Karl looked at his car.

3 Tom was sitting on the porch when he ran out the door as Bob was leaving the house.Bob called the dog's name, but he kept running away and disappeared.

37 Shelly let her dogs out in the backyard to play.Ronnetta later she noticed a groundhog peeking out from under the shed.She called the dogs back inside before they saw the critter.Once inside, the dogs saw the groundhog and started barking.The little groundhog ran under the fence to the neighbor's yard.

41 Carlos just got a new apartment.He needed a refrigerator.So Carlos went to the store.He found a very nice refrigerator and bought.Carlos now had a new refrigerator.

62 John was sitting at his desk.

64 My wife was lonely and depressed and he had no way to express himself.

66 My wife was lonely and depressed and he had no way to express himself.

73 Turner was a brand new private detective.A young girl came into his office in tears.She had lost her dog.Turner took the missing dog poster and a pencil and wrote down the information.

85 Mark was driving down the street when his check engine light came on.He noticed a strange smell, too.Mark knew something was wrong, so he took the car to the mechanic.

86 Shannon hated having a dirty house.She bought a giant container of cleanser..She sprayed it all over her house.She wiped down each surface.

Text classified as none but actual category is advanced\_needs

9 Lily was flying alone for the first time.

10 The dog was brown and white.No one knew where it came from.she was broken and let us ride here.

30 I was in the river fishing one day.At the bottom of the river I saw something glittery.

35 Dave had entered a raffle at work this past weekend.

48 Dennis had been to the beach since childhood.

69 Sarah owned a small business.

100 Tim had done something.He regretted it later.He apologized for what he did.He was never quite forgiven.

113 Andy liked swimming.

142 Joe needed a new haircut.Joe couldn't decide how he wanted his hair cut.

219 Lucy had been offline for months.

# After Oversampling and Getting Uniform Dataset

| sentence              |      |
|-----------------------|------|
| maslow                |      |
| <b>advanced_needs</b> | 6037 |
| <b>basic_needs</b>    | 8403 |
| <b>none</b>           | 2034 |

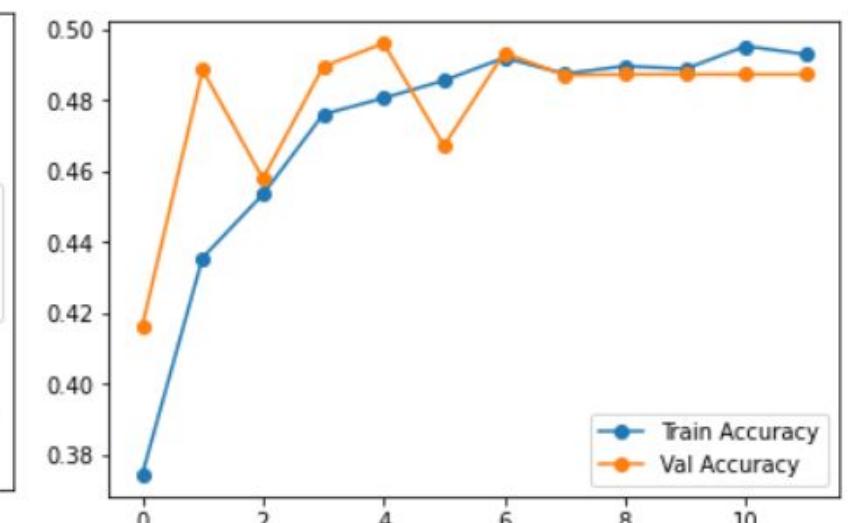
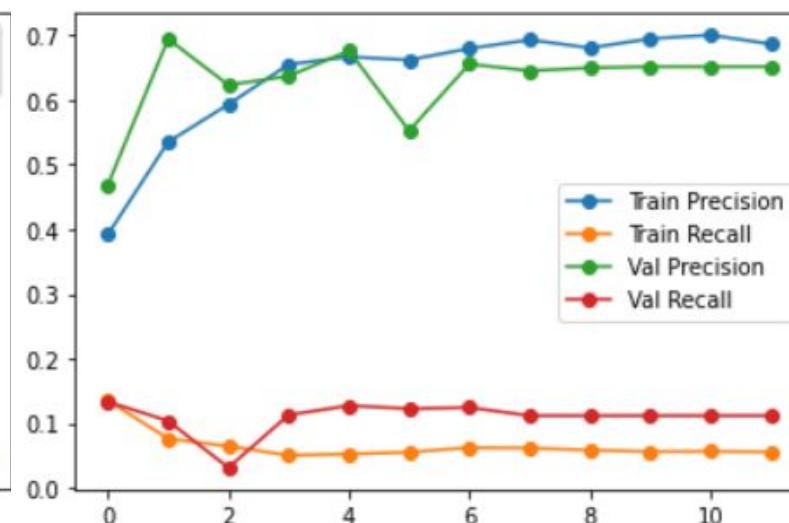
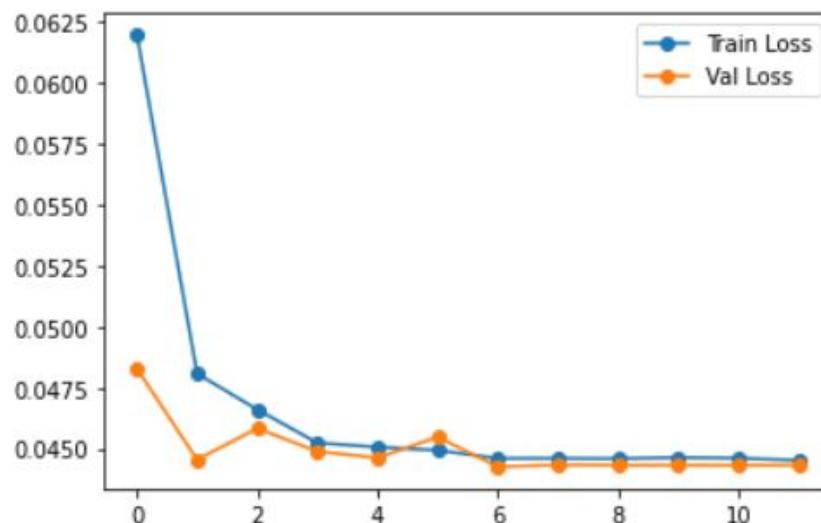


| sentence              |      |
|-----------------------|------|
| maslow                |      |
| <b>advanced_needs</b> | 8403 |
| <b>basic_needs</b>    | 8403 |
| <b>none</b>           | 8403 |

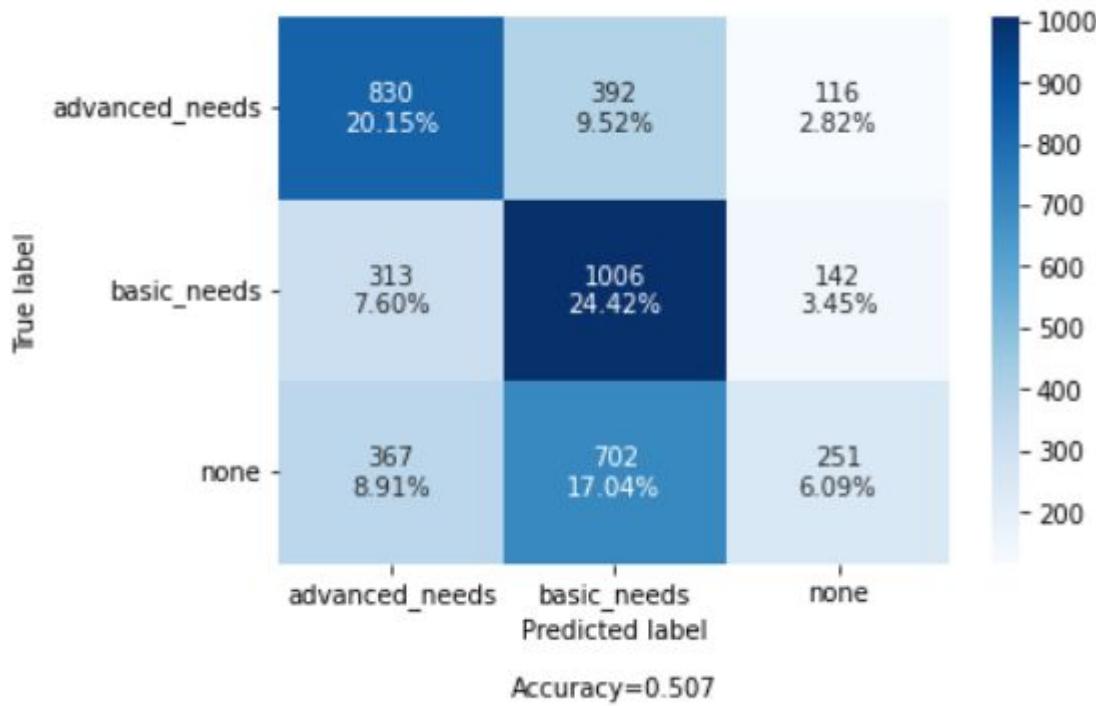
# Training BERT Model

UNC: 12082022\_2

- On Running upon 20 iterations: Time Taken For each Epoch: 137s(2.2min)
- Initial:
  - Loss: 0.0620 Val Accuracy: 0.4161
- Final:
  - Loss: 0.0439 Val Accuracy: 0.5067



# Evaluation Analysis



|                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.55      | 0.62   | 0.58     | 1338    |
| basic_needs    | 0.48      | 0.69   | 0.57     | 1461    |
| none           | 0.49      | 0.19   | 0.27     | 1320    |
| accuracy       |           |        | 0.51     | 4119    |
| macro avg      | 0.51      | 0.50   | 0.47     | 4119    |
| weighted avg   | 0.51      | 0.51   | 0.48     | 4119    |

# Few Misclassified Samples

Text classified as basic\_needs but actual category is none

22 Joe went to the bank to apply for a loan.  
28 Lloyd was out partying one night.He was having a great time.He was also drinking a little too much.  
87 Tom gave me a shirt for my birthday.I thought the shirt was very ugly and not my style.Mary's birthday was coming up next month.I put the shirt back in the box and rewrapped it.  
121 Emily wanted to go on a vacation.She searched for good deals on flights everyday.Eventually she found a great deal.She booked tickets to the Bahamas.  
180 Monday was making fudge with her mom.It was the holidays, the perfect time for fudge.She was stirring and stirring the hot fudge.She then slipped and threw the pan of hot fudge into the air.The fudge landed on a plate of cookies covering them all.  
214 Gina's brother had a friend named Joe.Gina disliked like Joe and always left when he came around.  
240 Sam needed help to move a couch in his house.  
251 My aunt lives on an island in Lake Michigan.You have to take a ferry to get there.  
298 Jen was at home.She decided to wash her hair.After she was done she looked into the mirror.Her hair was a different color.She realized she used the wrong bottle when washing her hair.  
316 Sally was so excited because today was the day the package would come.She had ordered a gift for her mother online.The mailman came to the door and dropped off the package.

Text classified as basic\_needs but actual category is advanced\_needs

0 Janice job requires her to travel a lot.She has no family of her own so she doesn't mind.Her friends feel sorry for her.They think at her age she should have a family of her own but she just be happy.  
20 Carrie had met a cute guy at the bar.She had given him her phone number when he asked.He promised to text her the next morning.When Carrie woke up the next morning she was shocked to find out he had never texted her back.  
33 Amy and Charles were going shopping for an engagement ring.They went to the mall and visited Kay Jewelers.They saw many rings within their price range.Jerry finally saw the ring of her dreams.  
38 A boy named Jerry had been invited to ride the ferris wheel.Dalton's mother warned him not to eat before getting on the ride.Dalton ate lots of carnival food that night.Dalton got sick on the ride.  
40 Jerry had been to the beach with his dad and his dog.Jerry had been playing with his dog and had stepped on a piece of catfish, but one snapped his pole in half.Jerry went to the store to buy a new fishing pole.Jerry came home with two because he couldn't decide.  
51 Jerry wanted to go on a vacation.  
52 Jerry had been to a birthday party.He went shopping for the food he would cook.Jake told the butcher he wanted to purchase veal.  
188 Zoey was wondering where to go on spring break.He couldn't decide in time.All her friends went to Malibu.  
113 Ron wanted to eat healthy but he didn't afford one.Though he began eating after school lunching dishes.  
124 Ken was tired of being laughed at for his lack of musicality.He took membership at his newest health club.

Text classified as advanced\_needs but actual category is none

5 Kay was taking piano lessons.Her teacher was an accomplished musician.Kay was working on a piece to perform at the annual recital.She learned a lot from her teacher.  
56 Juanita had always wanted to learn how to play the flute.She decided to start taking lessons.At first the flute lessons were very difficult.  
59 Kate always recycles.She would crush all her cans.One day she slipped and cut her hand badly.  
82 Cora wanted to get a new dress.  
88 Millie's class was learning about alternative medicine.They visited an acupuncturist to learn more about it.Milly was shocked by how long the needles were.The practitioners asked for a volunteer to have a needle inserted.Milly moved to the back of the line to make sure he didn't pick her.  
228 Karen rejected the supplemental coverage on her insurance.  
238 Jerry was a great comedian.Everyone loved watching his routine.  
321 Dennis loved comic books.He collected many different kinds.His favourites were Beano and Marvel.Beeno was a favourite because of Dennis the Menace.  
342 Fred was a high school student at a small school.  
358 Pablo moved from Puerto Rico at age 5.He began school in the United States.School was hard for him because he knew no english.

Text classified as advanced\_needs but actual category is basic\_needs  
3 I was bullied in high school.I had one bully in particular.She terrorized me almost everyday in school.  
13 I had a pet lizard named Bob.I had to keep it in a cage because it was a pet and I was scared.Everyone was saying it was the end of the world and technology.So to keep him off of it Cody played Pokemon Blue on his gameboy.  
15 John had a pet lizard named Bob.  
27 Lisa had a job Interview in three days.She was nervous and unprepared.Lisa decided to study for the interview.She practiced for nine hours every day.  
29 One day in 1982 my cousin called me.She works for a state agency.She told me she heard her agency was hiring.I scoffed at her, as the agency was very political.I managed to get a job.  
38 Bob's dog ran out the door as Bob was leaving the house.Bob called the dog's name, but he kept running away and disappeared.  
40 Cora was sad her father had passed away.  
42 Cora was sad her father had passed away.  
44 Cora was sad her father had passed away.  
46 Cora was sad her father had passed away.  
54 Kate wanted to make an omelette for breakfast.He wanted to make a small omelette with two eggs.He could also make a big omelette with four eggs.  
49 Harry was making a sandwich with butter.Then she realized she was out of butter.She decided to use margarine instead.Then Margery realized something was wrong.she was Margery making margarine.  
65 Kate needed a new hat.She decided to make her own.She gathered the materials and she found a tutorial.

Text classified as none but actual category is basic\_needs  
2 Sam was riding his bicycle in the park.  
8 One day, Bob's dog ran out the door as Bob was leaving the house.Bob called the dog's name, but he kept running away and disappeared.  
10 Cora was a violent terrorist who decided to kill all the people in the city.Silently she stayed up all night she could barely stay awake.  
16 She had a violent temper and she fell asleep after her last sleepover.  
37 Shelly let the dogs out in the backyard to play.Moments later she noticed a groundhog peeking out from under the shed.She called the dogs back inside and the dogs ran to the critter.Once inside, the dogs saw the groundhog and started barking.The little groundhog ran under the fence to the neighbor's yard.  
40 Carlos just got a new apartment.He needed a refrigerator.  
45 When Jon fell alone, he always had a few friends to keep him company.Jon liked to scatter bread-crumb for the ducks.Sometimes he played with dogs and talked to their owners.Jon was always lonely and he liked to feel safe.  
47 John was always easily spooked.John went to the movies with his friends.They saw a very scary horror movie.John was pretty shaken up by the movie.  
49 John was always easily spooked.John went to the movies with his friends.They saw a very scary horror movie.John was pretty shaken up by the movie.  
58 Lemmy pushed the stroller up the stairs while watching the news.The stroller hit a baby in the stairs.The baby in the stroller proceeded to fall out of the bottom of the stairs.The baby was passed seamlessly between 3 people.The baby settled in Chad's lap at the bottom of the stairs.  
60 John was always easily spooked.John went to the movies with his friends.They saw a very scary horror movie.John was pretty shaken up by the movie.  
64 Kevin was lonely and depressed.And he had no way to express himself.

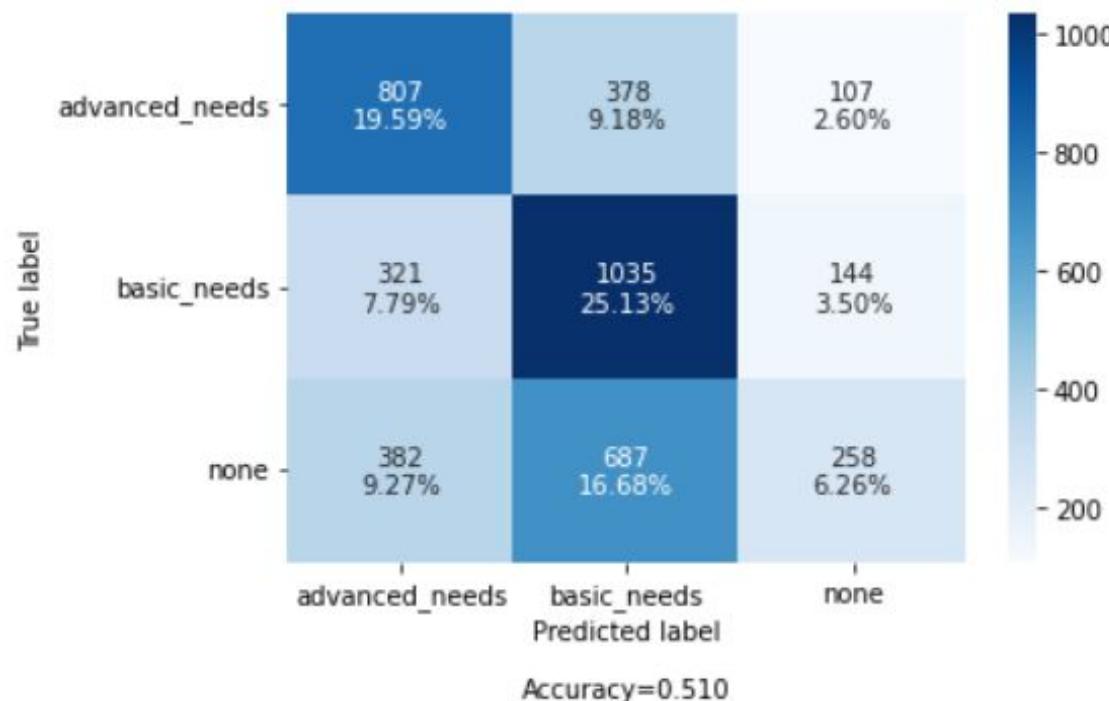
Text classified as none but actual category is advanced\_needs

9 Lily was flying alone for the first time.  
20 Tom's parents moved to our house.It was brown and white.No one knew where it came from.She was broken and let us ride here.  
30 I was in the river fishing one day.At the bottom of the river I saw something glittery.  
35 Dave had entered a raffle at work this past weekend.  
40 Drawing had been an escape for Jenna since childhood in an angry home.With sidewalk chalk, she drew magical places where no one yelled.  
69 Sarah owned a small business.  
83 Alex was on a camping trip.  
100 Sara bought a lottery ticket.  
102 The man got angry.He did something.He regretted it later.He apologized for what he did.He was never quite forgiven.  
107 Sally liked beetles and was playing with them one day.

# After applying K=5 Fold Cross Validation

- After performing 5 splits and training the model for 5 epochs on train set and testing on validation set. Later the best model was used to evaluate on Test set

|                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.53      | 0.62   | 0.58     | 1292    |
| basic_needs    | 0.49      | 0.69   | 0.58     | 1500    |
| none           | 0.51      | 0.19   | 0.28     | 1327    |
| accuracy       |           |        | 0.51     | 4119    |
| macro avg      | 0.51      | 0.50   | 0.48     | 4119    |
| weighted avg   | 0.51      | 0.51   | 0.48     | 4119    |



# Classification Need Vs No Need using augmented train Data

| sentence |                    |              |           |        |          |         |
|----------|--------------------|--------------|-----------|--------|----------|---------|
|          |                    |              |           |        |          |         |
|          |                    |              |           |        |          |         |
| maslow   | UNC:<br>12082022_4 |              | precision | recall | f1-score | support |
| need     | 14440              | need         | 0.95      | 0.88   | 0.91     | 3879    |
| no need  | 5528               | no need      | 0.11      | 0.23   | 0.14     | 240     |
|          |                    | accuracy     |           |        | 0.84     | 4119    |
|          |                    | macro avg    | 0.53      | 0.55   | 0.53     | 4119    |
|          |                    | weighted avg | 0.90      | 0.84   | 0.87     | 4119    |

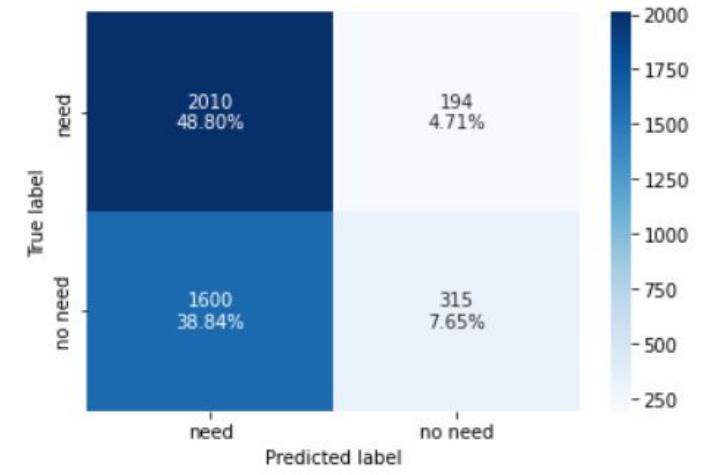
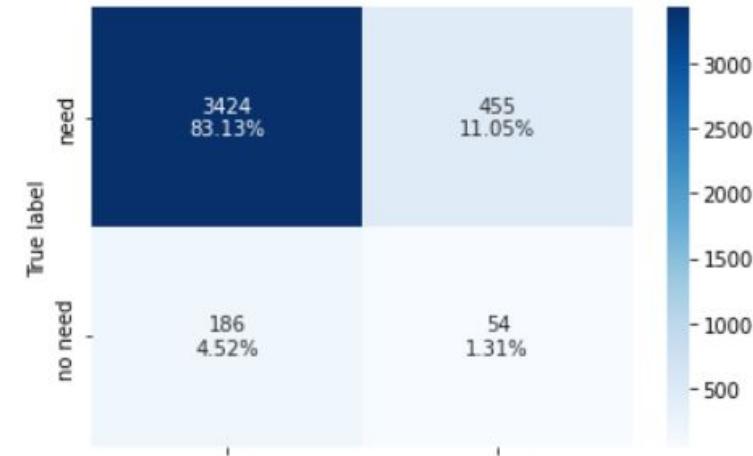
  

| sentence |                    |              |           |        |          |         |
|----------|--------------------|--------------|-----------|--------|----------|---------|
|          |                    |              |           |        |          |         |
|          |                    |              |           |        |          |         |
| maslow   | UNC:<br>12082022_5 |              | precision | recall | f1-score | support |
| need     | 5528               | need         | 0.56      | 0.91   | 0.69     | 2204    |
| no need  | 5528               | no need      | 0.62      | 0.16   | 0.26     | 1915    |
|          |                    | accuracy     |           |        | 0.56     | 4119    |
|          |                    | macro avg    | 0.59      | 0.54   | 0.48     | 4119    |
|          |                    | weighted avg | 0.59      | 0.56   | 0.49     | 4119    |

| sentence |       |  |  |  |  |  |
|----------|-------|--|--|--|--|--|
|          |       |  |  |  |  |  |
|          |       |  |  |  |  |  |
| maslow   |       |  |  |  |  |  |
| need     | 14440 |  |  |  |  |  |
| no need  | 14440 |  |  |  |  |  |

Training Stopped Suddenly



Accuracy=0.564

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Need  
Distributions

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words:59  
words:60

No Need Distributions

# Change of Maslow Category w.r.t Context

Valerie was getting ready for a formal dance.

Esteem

Valerie was getting ready for a formal dance. She has been preparing for hours. As she was ready to leave, her acrylic nail broke.

None

Valerie was getting ready for a formal dance. She has been preparing for hours. As she was ready to leave, her acrylic nail broke. She snapped off all of her faux nails.

Stability

Valerie was getting ready for a formal dance. She has been preparing for hours. As she was ready to leave, her acrylic nail broke. She snapped off all of her faux nails. She didn't have time to feel pity about them.

Esteem

```
[101] new_data.iloc[4][1]
"valerie was getting ready for a formal dance.she had been preparing for hours..as she was ready to leave, her acrylic nail broke.she snapped off all of her faux nails."
[102] new_data.iloc[5][1]
"valerie was getting ready for a formal dance.she had been preparing for hours..as she was ready to leave, her acrylic nail broke."
[103] new_data.iloc[6][1]
"valerie was getting ready for a formal dance..she had been preparing for hours..as she was ready to leave, her acrylic nail broke..she snapped off all of her faux nails."
[104] new_data = new_data.reset_index()
new_data.loc[0:4][1]
```

|   | 1151  | Valerie was getting ready for a formal dance... esteem    | contact  | 1 |
|---|-------|---|----------|---|
| 1 | 8934  | Valerie was getting ready for a formal dance... none      | none     | 1 |
| 2 | 14816 | Valerie was getting ready for a formal dance... stability | order    | 1 |
| 3 | 16445 | Valerie was getting ready for a formal dance... esteem    | approval | 1 |
| 4 |       |   |          |   |

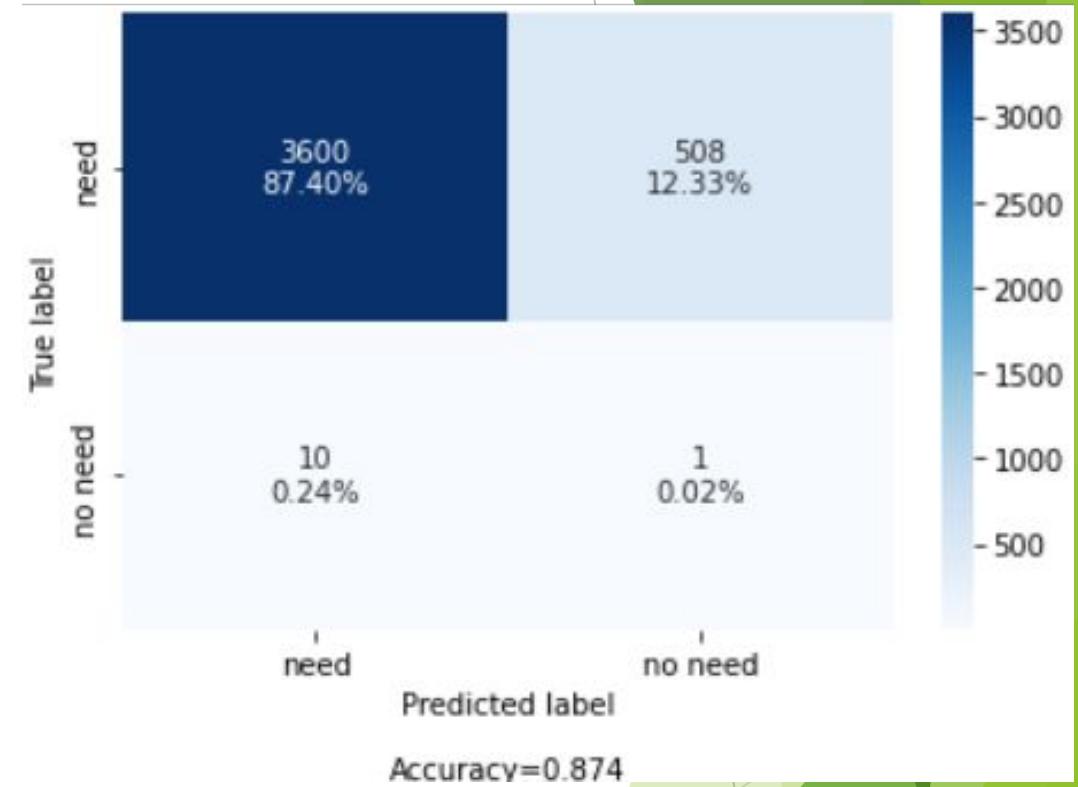
# Classification Need Vs No Need using original train and test data

Train Data

| sentence |       |
|----------|-------|
| maslow   | need  |
| need     | 14440 |
| no need  | 2034  |

|        |              | precision | recall | f1-score | support |
|--------|--------------|-----------|--------|----------|---------|
| maslow | need         | 1.00      | 0.88   | 0.93     | 4108    |
|        | no need      | 0.00      | 0.09   | 0.00     | 11      |
|        | accuracy     |           |        | 0.87     | 4119    |
|        | macro avg    | 0.50      | 0.48   | 0.47     | 4119    |
|        | weighted avg | 0.99      | 0.87   | 0.93     | 4119    |

UNC:  
16082022\_1



In UNC: 12082022\_2 we found that most of the misclassified samples were predicted correctly and think that the annotations made by annotators were inaccurate. So we tried to look upon the sentences which were categorised as "no need" to check if they really belong to class "no need" by reannotating it

# Classification Need Vs No Need using original train and test data

Category No Need in the Test Set was reannotated.

| sentence |           |      |
|----------|-----------|------|
| maslow   | annotator |      |
| need     | ajinkya   | 95   |
|          | anish     | 94   |
|          | gurudeep  | 58   |
|          | na        | 3610 |
|          | vivek     | 5    |
| no need  | ajinkya   | 32   |
|          | anish     | 33   |
|          | gurudeep  | 68   |
|          | vivek     | 122  |

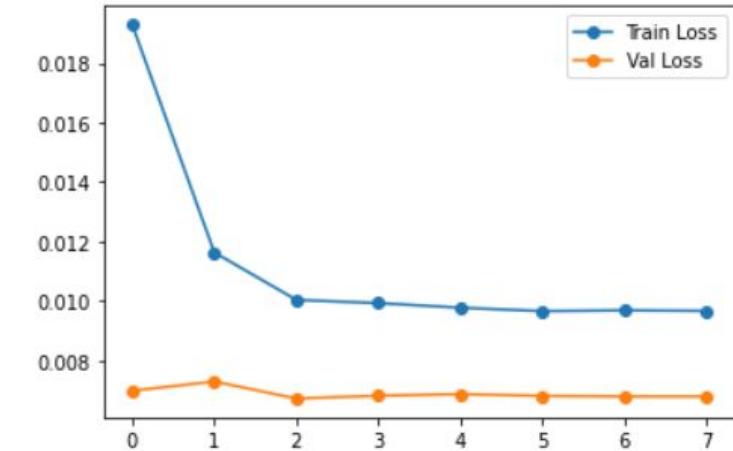
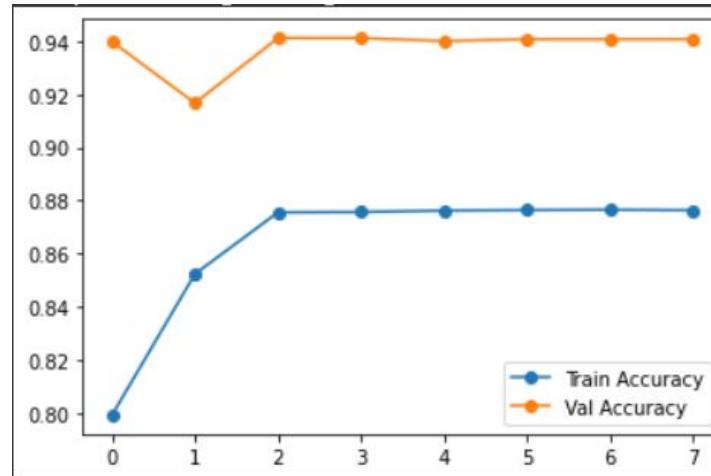
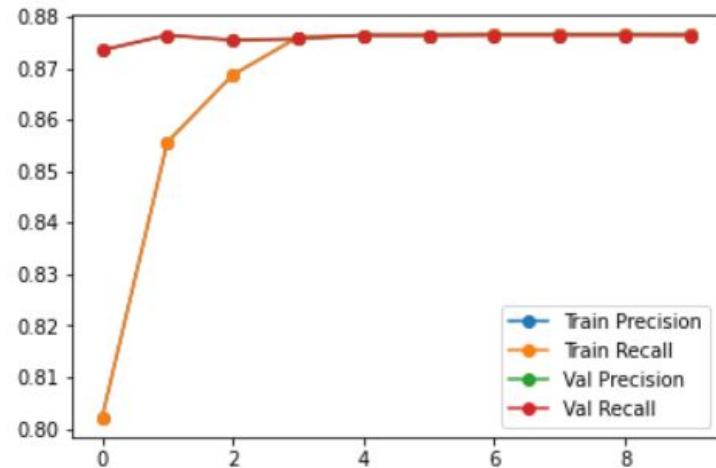
Test Set after reannotation  
of no need category only



| sentence |      |  |
|----------|------|--|
| maslow   |      |  |
| need     | 3862 |  |
| no need  | 255  |  |

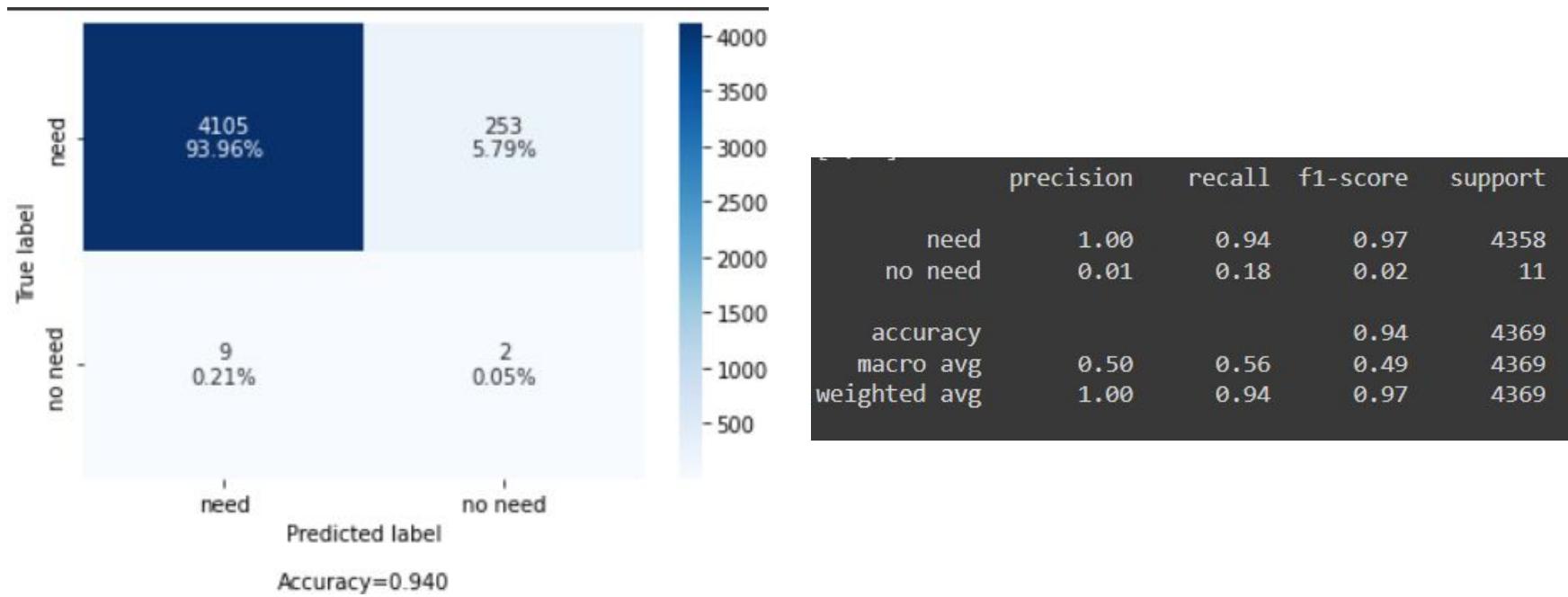
Train Set

| sentence |       |  |
|----------|-------|--|
| maslow   |       |  |
| need     | 14440 |  |
| no need  | 2034  |  |



# Training BERT Model

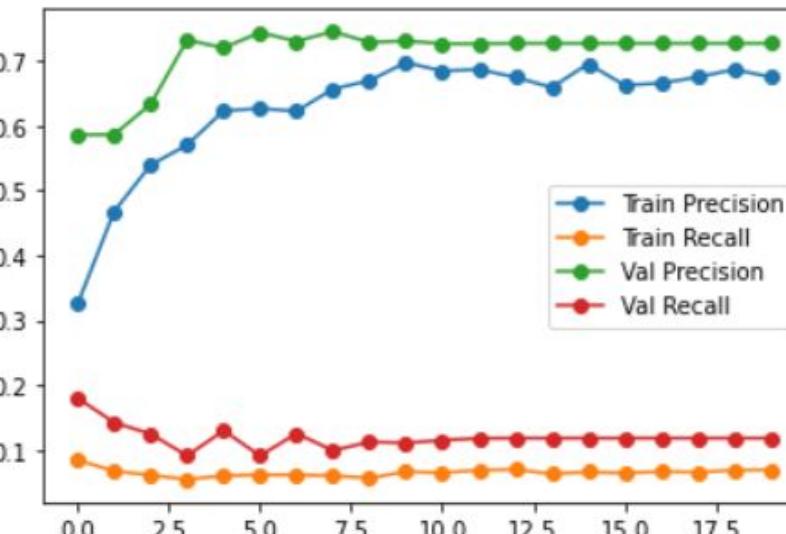
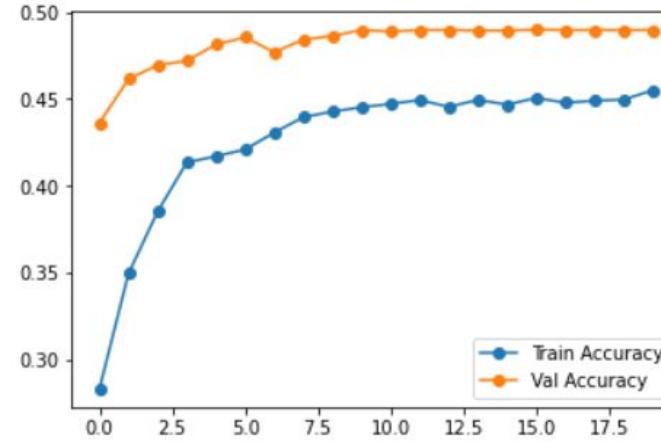
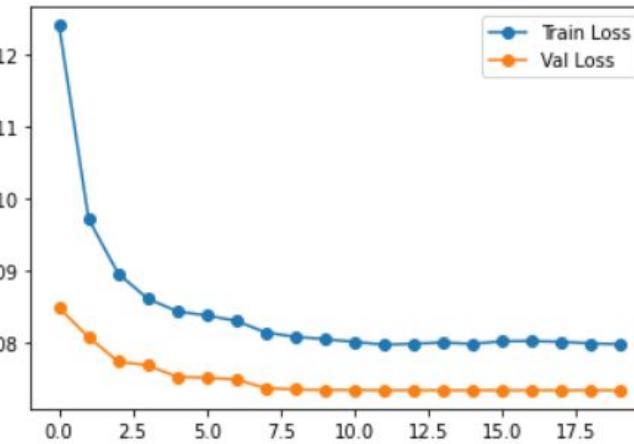
UNC: 17082022\_2



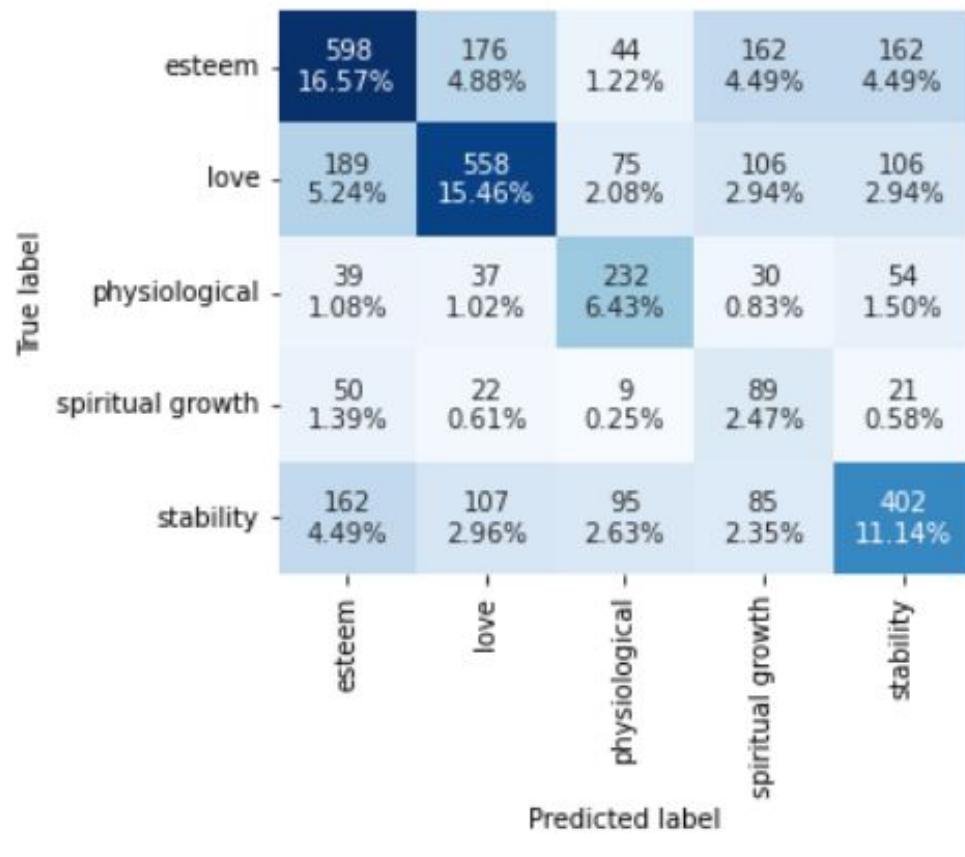
# Evaluation Analysis

# Multi Class Classification with 5 Maslow needs using Train Data

|                  | sentence |
|------------------|----------|
| maslow           |          |
| esteem           | 4149     |
| love             | 3602     |
| physiological    | 1822     |
| spiritual growth | 1888     |
| stability        | 2979     |



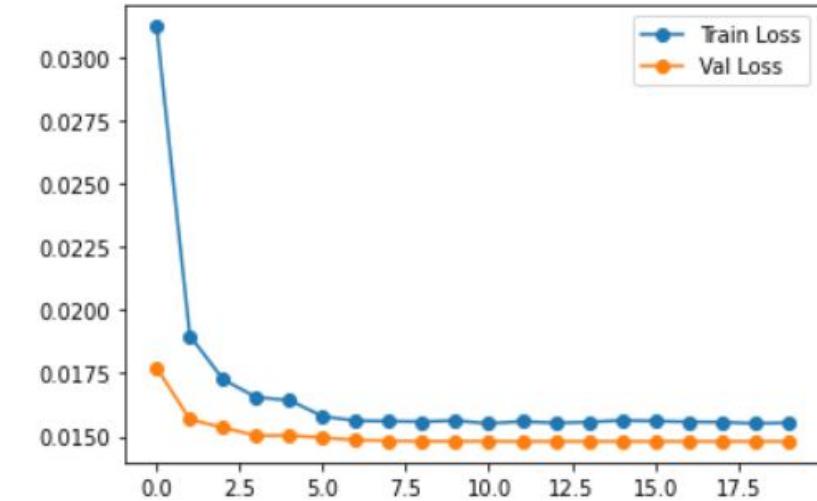
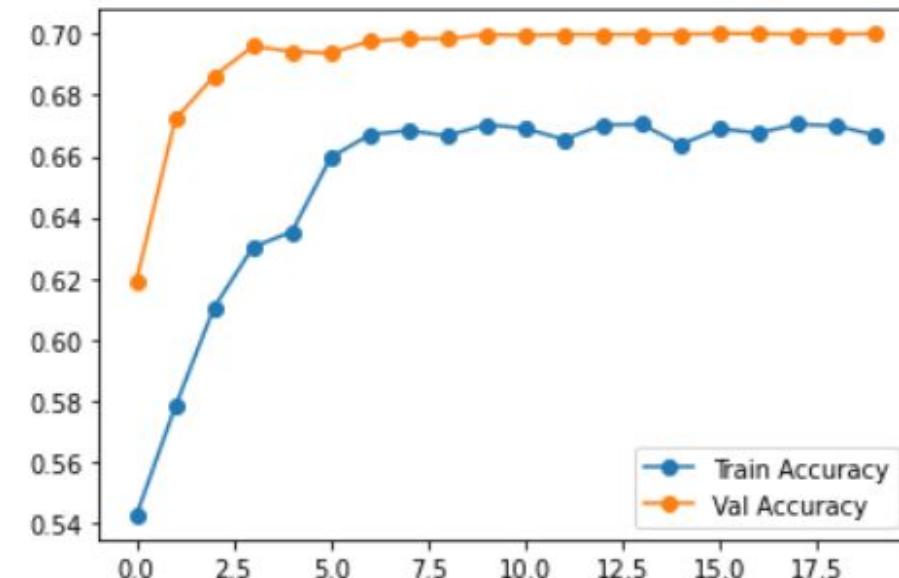
# Evaluation Analysis



|                  | precision | recall | f1-score | support |
|------------------|-----------|--------|----------|---------|
| esteem           | 0.58      | 0.52   | 0.55     | 1142    |
| love             | 0.62      | 0.54   | 0.58     | 1034    |
| physiological    | 0.51      | 0.59   | 0.55     | 392     |
| spiritual growth | 0.19      | 0.47   | 0.27     | 191     |
| stability        | 0.54      | 0.47   | 0.50     | 851     |
| accuracy         |           |        | 0.52     | 3610    |
| macro avg        | 0.49      | 0.52   | 0.49     | 3610    |
| weighted avg     | 0.55      | 0.52   | 0.53     | 3610    |

**sentence**  
**maslow**

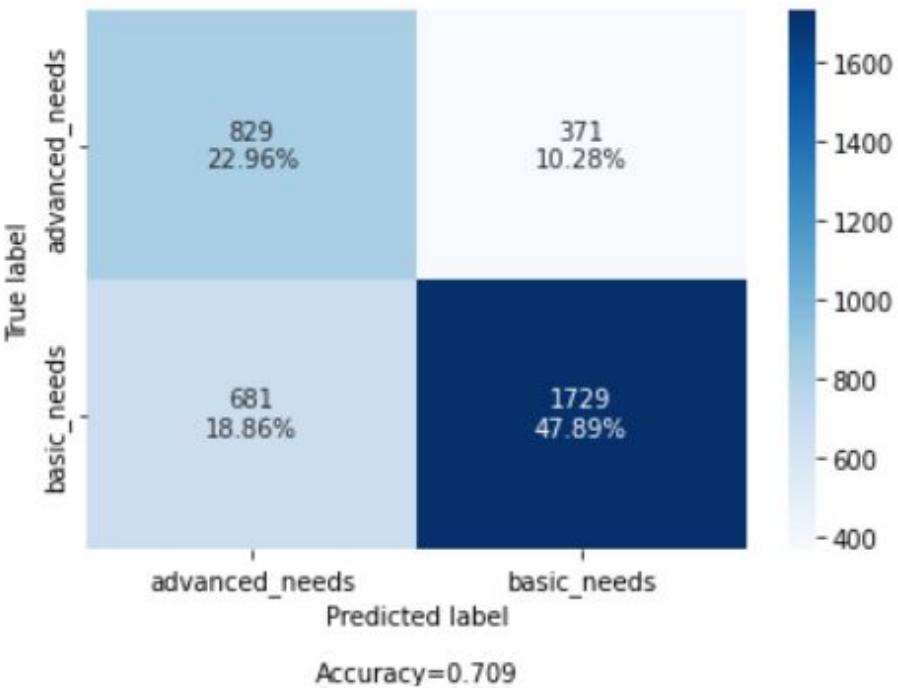
**advanced\_needs** 6037  
**basic\_needs** 8403



## Classification Basic Need Vs Advanced Need using train Data

- On Running upon 20 iterations: Time Taken For each Epoch: 83s (1.3min)
- Initial:
  - Loss: 0.0312 Val Accuracy: 0.6194
- Final:
  - Loss: 0.0146 Val Accuracy: 0.7086

# Evaluation Analysis



|                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.55      | 0.69   | 0.61     | 1200    |
| basic_needs    | 0.82      | 0.72   | 0.77     | 2410    |
| accuracy       |           |        | 0.71     | 3610    |
| macro avg      | 0.69      | 0.70   | 0.69     | 3610    |
| weighted avg   | 0.73      | 0.71   | 0.72     | 3610    |

# Few Misclassified Samples

Text classified as basic\_needs but actual category is advanced\_needs

0 Jamies job requires her to travel a lot. She has no family of her own so she doesn't mind. Her friends feel sorry for her. They think at her age she should have a family. She promised herself to take her time with it and just be happy.

6 Lily was flying alone for the first time.

14 In August Billy is going overseas for the war.

17 The horse showed up to our house. It was brown and white. No one knew where it came from. She was broken and let us ride here.

22 Carrie had met a cute guy at the bar. She had given him her phone number when he asked. He promised to text her the next morning. When Carrie woke up, she tried to brace for disappointment.

25 I was in the river fishing one day. At the bottom of the river I saw something glittery.

28 Amy and Charles were going shopping for an engagement ring. They went to the mall and visited Kay Jewelers. They saw many rings within their price range. Amy finally saw the ring of her dreams.

30 Dave had entered a raffle at work this past weekend.

33 A carnival was coming to town. Dalton loved to ride the ferris wheel. Dalton's mother warned him not to eat before getting on the ride. Dalton ate lots of carnival food that night. Dalton got sick on the ride.

39 Jerry went fishing last Sunday. He caught a lot of catfish, but one snapped his pole in half. Jerry went to the store to buy a new fishing pole. Jerry came home with two because he couldn't decide.

Text classified as advanced\_needs but actual category is basic\_needs

3 I was bullied in high school. I had one bully in particular. She terrorized me almost everyday in school.

9 It was the year coming up to the millennium and Cody was scared. Everyone was saying it was the end of the world and technology. So to keep his mind off of it Cody played Pokemon Blue on his gameboy.

10 Jones exercised every night.

23 Lisa had a job interview in three days. She was nervous and unprepared. Lisa decided to study for the interview. She practiced for nine hours every day.

24 One day in 1982 my cousin called me. She works for a state agency. She told me she heard her agency was hiring. I scoffed at her, as the agency was very political. I managed to get a job.

31 Rena and Jerry went to highschool together. They immediately fell in love.

49 Kyle wanted to make an omelette for breakfast. He had four eggs left. He knew he could make a small omelette with two eggs. He could also make a big omelette with four eggs.

53 Margery was making toast with butter. Then she realized she was out of butter. She decided to use margarine instead. Then Margery realized something amusing. She was Margery making margarine.

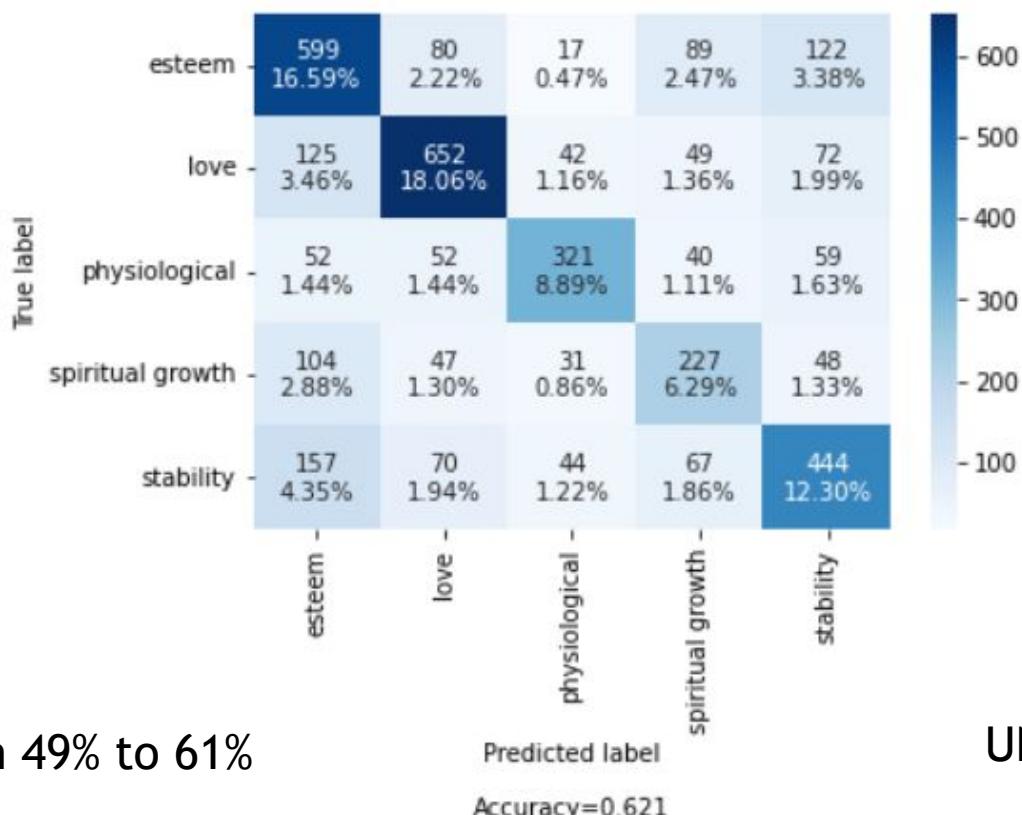
58 Kate needed a new hat. She decided to make her own. She gathered the materials and she found a tutorial.

61 Conrad enjoyed writing stories. One morning, Conrad discovered he could be paid to write stories! Conrad spent the entire day writing fantastic tales. At the end of the day, Conrad was paid for his stories.

# A New Model

➡

|                  | precision | recall | f1-score | support |
|------------------|-----------|--------|----------|---------|
| esteem           | 0.66      | 0.58   | 0.62     | 1037    |
| love             | 0.69      | 0.72   | 0.71     | 901     |
| physiological    | 0.61      | 0.71   | 0.66     | 455     |
| spiritual growth | 0.50      | 0.48   | 0.49     | 472     |
| stability        | 0.57      | 0.60   | 0.58     | 745     |
| accuracy         |           |        | 0.62     | 3610    |
| macro avg        | 0.61      | 0.62   | 0.61     | 3610    |
| weighted avg     | 0.62      | 0.62   | 0.62     | 3610    |



```

max_len = 70
input_ids = Input(shape = (max_len,), dtype = tf.int32, name = 'input_ids')
input_mask = Input(shape = (max_len,), dtype = tf.int32, name = 'attention_mask')
embeddings = bert(input_ids, attention_mask = input_mask)[0]
out = tf.keras.layers.GlobalMaxPool1D()(embeddings)
out = Dense(128, activation = 'relu')(out)
out = tf.keras.layers.Dropout(0.1)(out)
out = Dense(32, activation = 'relu')(out)
y = Dense(5, activation = 'sigmoid')(out)
model = tf.keras.Model(inputs = [input_ids, input_mask], outputs = y)
model.layers[2].trainable = True

```

Multi Label Prediction on Reddit Data:  
UNC: 26082022\_1

UNC: 21082022\_1

# Misclassified Categories

Text classified as physiological but actual category is esteem  
81 the husband was a prude in the bathroom with a new beer cooler he put it on the front porch his wife was horrified  
137 she was a bit frightened because now that his wife  
285 marge was proud that she fed her kids oatmeal for breakfast  
287 my wife and i went out to dinner on valentines day we went to a restaurant near our home the bread and drinks  
383 cindy was in a store picking up a pizza she swiped her card but for some reason it was denied she tried a few more times  
709 kyle wanted to make an omelette for breakfast he had four eggs left he knew he could make a small omelette with them  
731 he was on a blind date she hated it they go for a walk he never had a date like this was nervous but she tried  
775 maybe her heart was going to stop he turned a pale color she was scared their childrens babysitter let them  
810 the tiny green alien was made of plastic the girl giggled as it popped open against the fridge  
883 i went into the restaurant to buy a sandwich the restaurant owner was very frugal almost miserly

Text classified as physiological but actual category is love  
3 cindy is very tired she will not take a nap  
4 she was so tired she fell asleep sitting over abundance of cardboard around i decided to use it to get out the hot glue gun and  
112 dan was sleeping in a full size bedsover when dana's girlfriend moved in he needed a larger bed and his girlfriend went to the store to purchase  
169 after the bell rang my friends decided to go into room 42  
43 she was so tired she fell asleep in the car on the way home  
433 kenny ordered a pitcher of beer for him and his friend the beer came while he was playing pool the time kenny got back the pitcher was empty  
608 charles was so tired he fell asleep in his car on the way home  
631 luke was so tired he fell asleep in his car on the way home  
645 luke lived in a treehouse behind his families house climbed the branches like a monkey one day he was being careless and fell from the tree  
749 sally was eating a burger at home she got thirsty she got up to look for something to drink she found some juice in the refrigerator

Text classified as love but actual category is esteem  
12 julie wanted to cook for her family she decided to cook spaghetti  
53 amy liked to do art projects she painted a wine glass with her name  
140 when they got home it was time to open gifts it was the boys 13th birthday they gave him a new tv for his room he said he could not wait to play  
147 abby was excited for her sweet 16 birthday party at the hotel  
193 friday night football is very popular in the south lived in alabama and everyone in the community was at the game it was a time for socializing  
206 isabelle was very proud of her long hair she took good care of them until she slept on the grass on her lawn when she woke up she realized her  
209 sally was so angry she begged her to stay up late to study for her final exams  
226 sally wanted a carrot cake for her birthday instead she got a chocolate cake she complained her mom told her the cake was not the point  
219 sally now found out that his savings was not enough for his tuition therefore he dropped out of his classes in an effort to remain alone he is poor  
241 juan wanted to be a country music star he knew that he would have to leave home and go to nashville when he turned 20 he decided it was time to go

Text classified as spiritual growth but actual category is esteem  
30 samantha always taught her how to be self sufficient even taught her how to change a tire on a car one day samantha tire blew while she  
88 was a hand wanted to sound different the guitarists were really creative they bought cellos banjos they played guitars with them  
142 adam wanted to be a rock star he begged his parents to let him go to a concert  
186 greg had just moved to a new schoolshe wanted to fit in so badly  
179 lindsay did not try very hard at her studies she preferred to talk to boys and skip class Lindsay made terrible grades and could not get into college  
237 adam built a scale model of his bedroom in a dollhouse  
300 sallys dream was to make it in hollywood she saved all her money and traveled to california  
303 sallys dream was to make it in hollywood her brother was very critical of his driving his brother thought he was talking too much and instead  
304 i thought sally how to make a movie film

Text classified as spiritual growth but actual category is love  
287 when i was a kid i loved harry potter my parents were very religious they went to church every sunday they even taught me reading a book they  
44 i had to go to the hospital because i was having a fever after one of the conferences we went to a ball game we had suits which were snoring  
292 susan's friends all liked to play tennis she did not know how to play tennis so she took tennis lessons all winter  
293 adam was meeting friends at a bar he went to the bar for the first time she stopped outside of the airport it was very rainy adam had come during a  
488 ton loves an old song he was never able to remember its name he did not know enough lyrics to look it up eventually tom hummed it to a few friends  
530 gina was walking around the poolside was talking on the phone  
747 adam was walking through the park when he saw his brother he wanted to help his brother got the kite out of the tree  
760 i went to a chinese christian church in boston from 1968 to 1981  
770 donna was walking through the park when something caught her eye  
771 she was in the middle of a wheelchair she was taking a walk when she heard a noise her son was dying just then she remembered her  
772 son was born in 1968 in this town his brother was very critical of his driving his brother thought he was talking too much and instead  
773 she was in the middle of a wheelchair she was taking a walk when she heard a noise her son was dying just then she remembered her

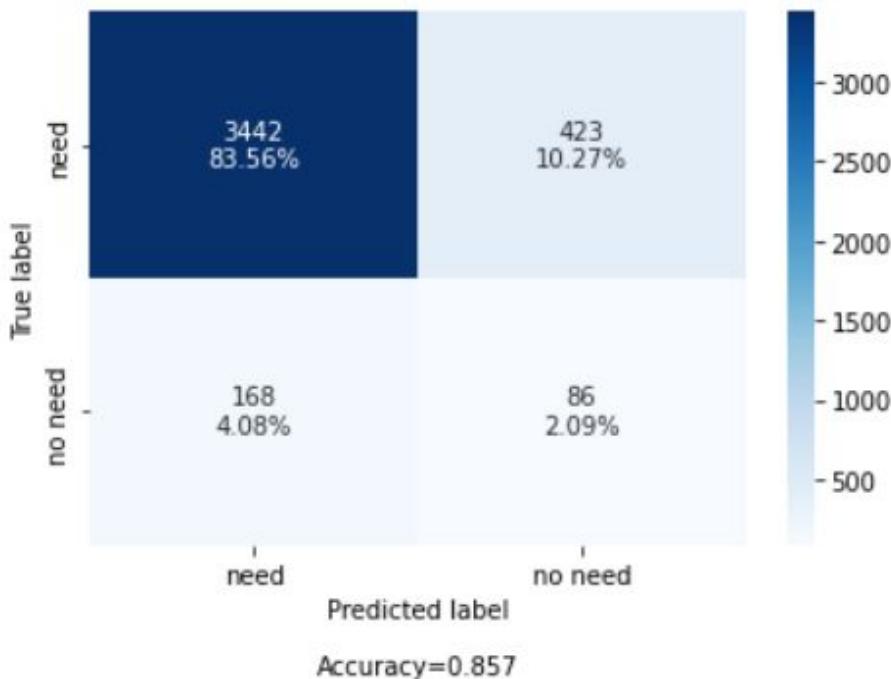
Text classified as stability but actual category is love  
15 lisa was having her birthday party at a hotel unfortunately the power went out so they had to switch the location  
50 fanny cared for a garden full of plants she would prefer to care for an animal as a pet her parents would not allow her to have an animal  
58 she was having a birthday party at a hotel unfortunately the power went out so they had to switch the location several times because paul put them into spams brother was worried  
203 the next door was empty elderly lady who lived there was gone  
224 pearl was meeting friends that night in a bar before she got there she was attacked in the street she had to go to the police station to file a report she was very scared she did not want to tell anyone about what happened she was very afraid she was alone  
224 pearl was meeting friends that night in a bar before she got there she was attacked in the street she had to go to the police station to file a report she was very scared she did not want to tell anyone about what happened she was very afraid she was alone  
250 tristan visited his grandmothers house on his birthday grandmother told him a story about a lucky charm the grandmother handed him the lucky charm  
414 john was taking his dog chance out for a long walk around the park chance kept barking at other dogs coming to a large fence in area  
453 adam was climbing a rock wall he could not walk this morning he had to take him to the hospital  
648 i am disabled while my wife works

Text classified as spiritual growth but actual category is physiological  
142 adam was climbing a rock wall he could not walk this morning he had to take him to the hospital  
110 the bear ambled along the forest path not in any hurry  
344 it took us three days to climb the mountains we neared the top we found a place to make camp  
350 adam was climbing a rock wall he could not walk this morning he had to take him to the hospital  
659 km was excited for the snow she knew that if there was enough she would have the day off school when she woke up in the morning everything was  
1059 km was excited for the snow she knew that if there was enough she would have the day off school when she woke up in the morning everything was  
1217 adam was climbing a rock wall he could not walk this morning he had to take him to the hospital  
1327 adam was climbing a rock wall he could not walk this morning he had to take him to the hospital  
1328 adam was climbing a rock wall he could not walk this morning he had to take him to the hospital

Text classified as stability but actual category is esteem  
9 sal needed a new car he had no idea what he wanted to go to the dealership he took test drives  
40 tina was climbing a cliff face she decided to go and get one but unfortunately she found no cheap ones  
75 when we went to get on the go carts we were stopped  
87 france and italy were at war for years the war was over when france threatened italy with the atomic bomb  
114 adam was climbing a rock wall he could not walk this morning he had to take him to the hospital  
130 tina was climbing a cliff face she was afraid she would fall unfortunately she made it safe  
238 alicia went rock climbing she started climbing the cliff face engulfed in smoke she was afraid she would fall unfortunately she made it safe  
300 tina was climbing a cliff face she was afraid she would fall unfortunately she made it safe  
304 brian went to a supermarket he needed some fruit he took some apples and put it into his pocket somebody saw him he was forced to pay for it  
309 jesse wanted to live debt free

# Need Vs No Need Classification on orig train and test data

|              | precision | recall | f1-score | support |
|--------------|-----------|--------|----------|---------|
| need         | 0.89      | 0.95   | 0.92     | 3610    |
| no need      | 0.34      | 0.17   | 0.23     | 509     |
| accuracy     |           |        | 0.86     | 4119    |
| macro avg    | 0.61      | 0.56   | 0.57     | 4119    |
| weighted avg | 0.82      | 0.86   | 0.83     | 4119    |



F1 Precision from 49% to 57%

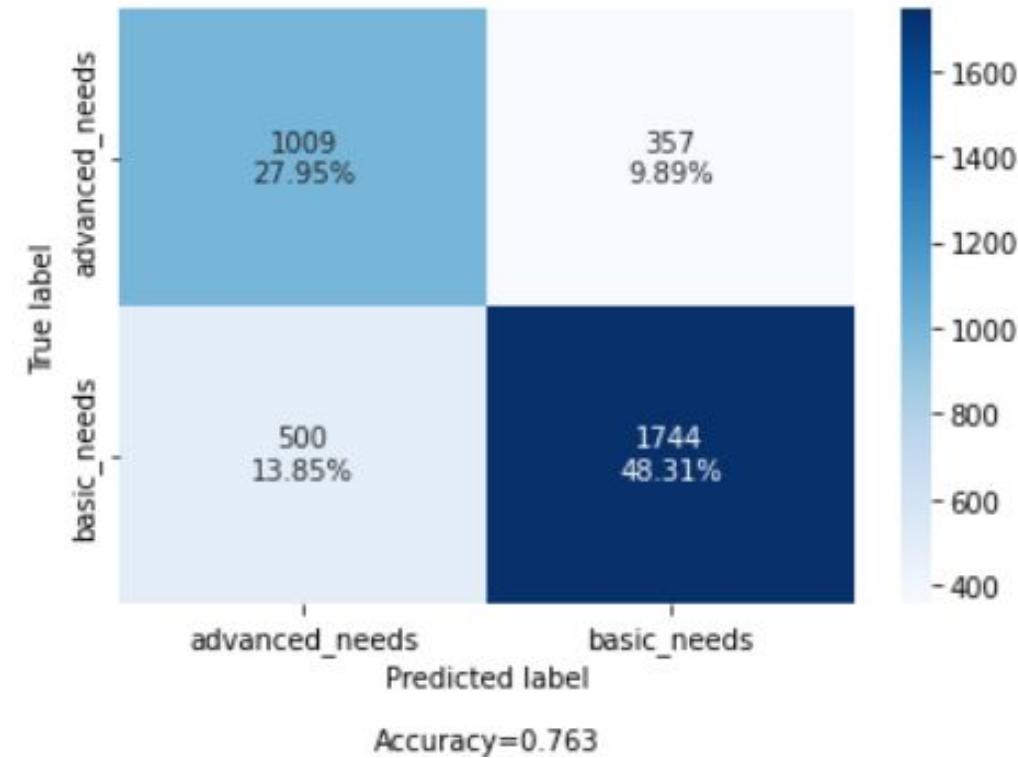
UNC: 23082022\_1

| Task  | Macro Avg | Classes |
|---|-----------|---------|
| 3 Classes Multi Classification Problem  | 0.45      | 3       |
| Augmented Train Dataset and Orig Test Set                                       | 0.48      | 3       |
| Augmented Oversampled Train Dataset and Orig Test Set                           | 0.47      | 3       |
| Augmented Oversampled Train Dataset and Orig Test Set + K Fold cross validation | 0.48      | 3       |
| Need vs No Need augmented train data  | 0.53      | 2       |
| Need vs No need Original train data   | 0.47      | 2       |
| Need vs No need Original train data after reannotation of none category         | 0.49      | 2       |
| Multi Classification with Train Data  | 0.49      | 5       |
| Multi Classification with Train Data  | 0.61      | 5       |
| Need vs No Need Classification on orig train data                               | 0.57      | 2       |

# Basic Vs Advanced Need Classification using orig train and test data

|                | precision | recall | f1-score | support |
|----------------|-----------|--------|----------|---------|
| advanced_needs | 0.74      | 0.67   | 0.70     | 1509    |
| basic_needs    | 0.78      | 0.83   | 0.80     | 2101    |
| accuracy       |           |        | 0.76     | 3610    |
| macro avg      | 0.76      | 0.75   | 0.75     | 3610    |
| weighted avg   | 0.76      | 0.76   | 0.76     | 3610    |

F1 Precision from 69% to 75%



# Few Misclassified Samples

Text classified as basic\_needs but actual category is advanced\_needs

0 john forgot he had a gig after workhe already promised to his wife to go shopping with herhe had to call her and cancel  
2 melba went to spend the night at her friend christines housethe two girls got along well up until bedtimechristine wanted t  
15 yesterday i took a bottle of iced coffee outsidei packed it in a shoulder bag with a booki sat on a bench read and drank  
17 my girlfriend planned a picnic for us last weekend  
20 the man turned on the ovenhe opened itthe oven was not hothe checked the elements  
21 levi spilled coffee on his shortshe took off his shortshe put his shorts in the sinkhe washed the shorts by hand  
22 charles ran out of clean clothes to wearhe put all of his dirty clothes in a bag  
43 tim was home alone  
60 jerry went fishing last sundayhe caught a lot of catfish but one snapped his pole in halfjerry went to the store to buy a  
73 i went to the bulls game last night

Text classified as advanced\_needs but actual category is basic\_needs

3 i chewed my pen at my desk  
32 tom was on vacationhim and his wife took several picturesunfortunately tom lost the memory cardsomeone else found it and posted it onlinetom v  
109 tim had a local coffee shophe decided to have a bloghe posted a lot of personal informationmuch of it was unsavory and hurt his businesstim v  
117 laura was really excited for her trip so she wanted to planshe was not sure exactly what to plan for so it was challengingshe looked around v  
121 tonedeaf melanie and her talented pal tried out for choir at schoolmelanie only mouthed the words while her friend sang aloudthe music teache  
125 john loved working with animalsafter inheriting the farm he happily spent all day on itnow he had a choice to makethere was not any work left  
149 jack was building a sand castle with turrets a drawbridge and moathe used ocean water to fill the moat and at that moment a wave hit  
152 todd was mowing his yard  
155 theo considered skipping superior to running or walkinghe felt that it was energyefficient and quick  
170 jon lived in a quaint town in hollandthere was a giant windmill in the center of townhe liked to sit near it and enjoy the weatherjon invitec



Thank you



# Resources Referred:

- ▶ For Augmentations:
  - ▶ [https://github.com/makcedward/nlpaug/blob/master/example/textual\\_augmenter.ipynb](https://github.com/makcedward/nlpaug/blob/master/example/textual_augmenter.ipynb)
  - ▶ <https://github.com/makcedward/nlpaug#augmenter>
  - ▶ <https://pypi.org/project/nlpaug/>
  - ▶ <https://www.analyticsvidhya.com/blog/2021/08/nlpaug-a-python-library-to-augment-your-text-data/>
  - ▶ <https://www.analyticsvidhya.com/blog/2022/02/text-data-augmentation-in-natural-language-processing-with-texattack/>
  - ▶ <https://textattack.readthedocs.io/en/latest/apidoc/textattack.augmentation.html>
- ▶ For Focal Accuracy And Class Weights:
  - ▶ [https://www.tensorflow.org/api\\_docs/python/tf/keras/losses/SparseCategoricalCrossentropy](https://www.tensorflow.org/api_docs/python/tf/keras/losses/SparseCategoricalCrossentropy)
  - ▶ [https://focal-loss.readthedocs.io/en/latest/generated/focal\\_loss.SparseCategoricalFocalLoss.html#focal\\_loss.SparseCategoricalFocalLoss](https://focal-loss.readthedocs.io/en/latest/generated/focal_loss.SparseCategoricalFocalLoss.html#focal_loss.SparseCategoricalFocalLoss)
  - ▶ [https://www.tensorflow.org/addons/api\\_docs/python/tfa/losses/SigmoidFocalCrossEntropy](https://www.tensorflow.org/addons/api_docs/python/tfa/losses/SigmoidFocalCrossEntropy)
  - ▶ <https://amaarora.github.io/2020/06/29/FocalLoss.html>